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AUGUST 1948

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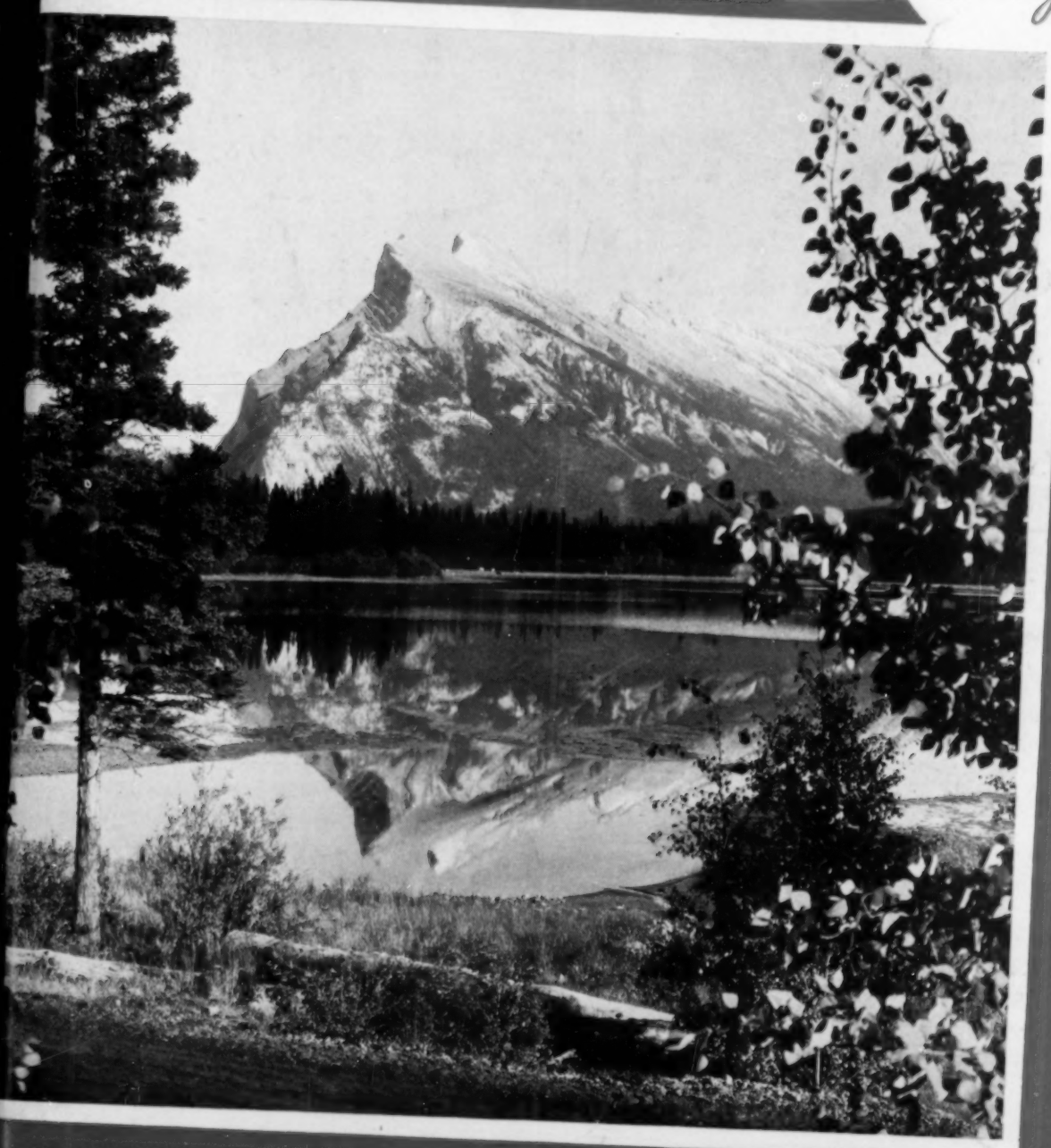


MOUNT RUNDLE
CANADIAN PEAK

Rugged height in popular tourist and vacation area of Alberta Province

VOLUME 53 • NUMBER 8

NEW YORK • LONDON

Sure Cure for Drill Doctors' "Headaches"

Rx Keep drills protected against rust and wear with Texaco Rock Drill Lubricants EP

TEXACO Rock Drill Lubricants EP are widely "prescribed" to keep drills in tiptop operating condition. When "taken as directed" amazing improvement in performance is frequently noted . . . more footage drilled, less servicing required, longer drill life.

As the name indicates, *Texaco Rock Drill Lubricants EP* have "extreme pressure" characteristics — ample film strength to protect moving parts even under the severest conditions. They flow readily, strongly resist oxidation, and prevent rust in drills running or idle.

Leading rock drill manufacturers approve *Texaco Rock Drill Lubricants EP* . . . available in viscosities for all types of drills and operating conditions.

For more efficient *compressor* operation, keep rings free, valves clean, air lines clear, with *Texaco Cetus, Alcaid or Algol Oil.*

A Texaco Lubrication Engineer will gladly help you select the proper lubricants for better air drill and compressor performance. Just call the nearest of the more than 2500 Texaco Wholesale Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

SEND FOR this new, illustrated 32-page book: "Lubrication of Air Drills and Compressors." Packed with facts and practical suggestions to help you increase drilling efficiency and reduce costs.

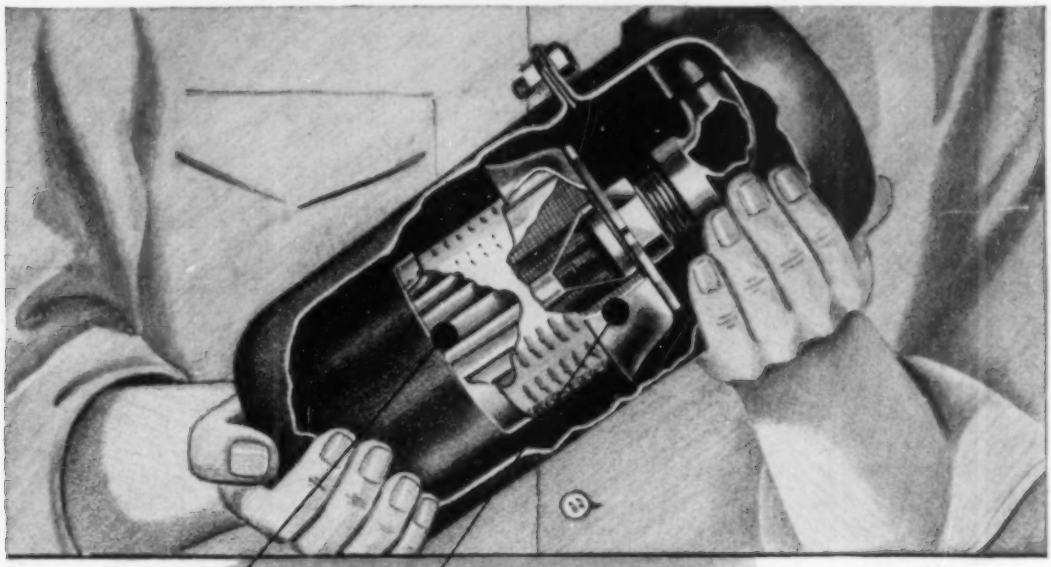
TEXACO
REG. T.M.

TEXACO Lubricants

FOR ALL AIR COMPRESSORS AND TOOLS

Tune in . . . Texaco Star Theatre every Wednesday night featuring Gordon MacRae and Evelyn Knight . . . ABC Network

STAYNEW PIPE LINE FILTERS



ELIMINATE

MOISTURE
OIL
DIRT
PIPE SCALE

from Compressed Air Lines

Tests prove that Staynew Filters often save their entire cost in just a few weeks. By preventing the passage of foreign matter, including moisture (water and oil), they prevent excess wear, costly freeze-ups, damage to materials and interference with processes.

EXCLUSIVE DOUBLE-ACTION PRINCIPLE PROVIDES:

MECHANICAL SEPARATION—Deflector Cup drives foreign matter to bottom of container where heavier particles are deposited.

FILTRATION—air or gas rises thru the original Radial Fin Insert which removes the lighter material.

DOLLINGER PROTECTOMOTOR STAYNEW FILTERS

IMPORTANT APPLICATIONS: Protection of Air-operated Tools and Controls • Paint Spraying • Sand Blasting • Air Displacement or Agitation of Liquids

COMPLETE DETAILS ON REQUEST

DOLLINGER CORPORATION

7 CENTRE PK., ROCHESTER 3, N. Y.
Representatives in Principal Cities

IN CANADA: McCarthy and Robinson, Toronto
Engineering Equipment Co., Montreal

FOR HANDLING AIR OR GAS—I-R Blowers Have the Preference

EXPERIENCE: The *first* centrifugal gas compressor for a fluid catalytic cracking plant, the *first* turboblower for gas pipeline transmission, the *first* blowers for 40 lb blast furnace blowing... they are all Ingersoll-Rand. This is what we mean when we say there is a preference for I-R blowers.

PERFORMANCE: Preference for I-R Blowers is also based on the low Power costs, Low Maintenance Costs and High Availability Factor of every blower we've ever built... and we've built thousands of them. If you are buying a blower, investigate power consumption... check up on maintenance costs... find out if the blower can give continuous performance for long periods ...these are the only sound reasons for blower selection.

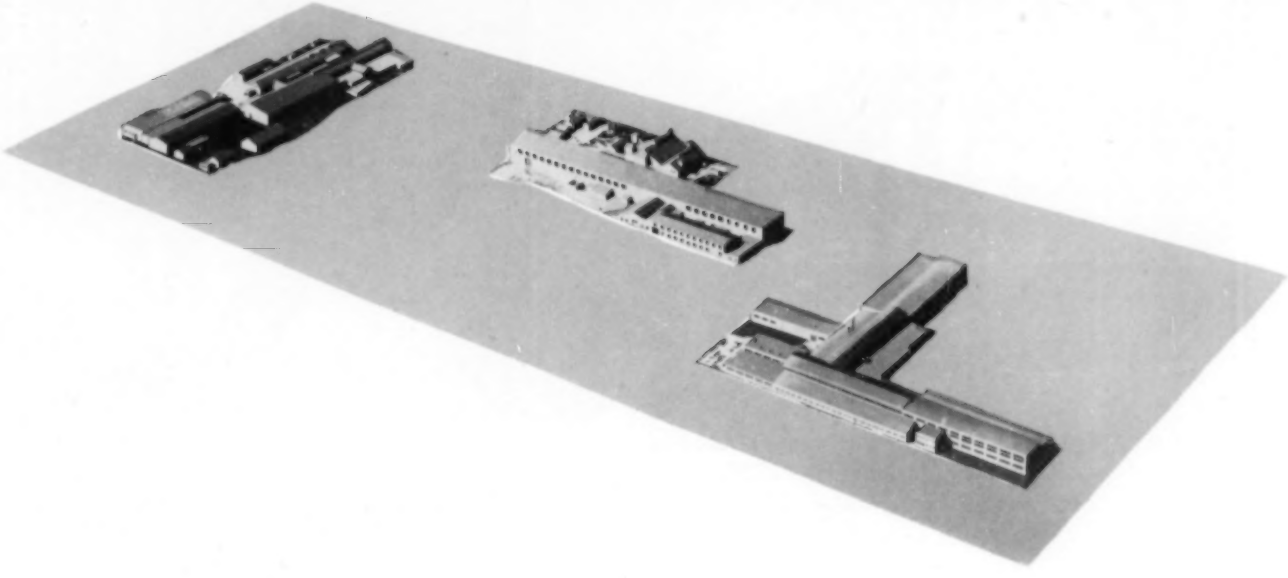
SERVICE: Service that is friendly and competent, backed by full scale engineering and research facilities is another part of the preference for I-R Blowers. Whatever your blower problem, a phone call to an Ingersoll-Rand Branch Office will put you in touch with a thoroughly qualified engineer who will be glad to assist you in any way he can. Take advantage of his experience.

224-12

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

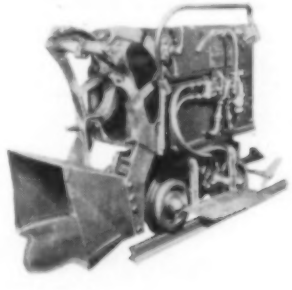
To Speed Your RockerShovels



Eimco's new plant additions now make it possible to offer quick certain deliveries on popular models—30 days regularly or sooner if required.

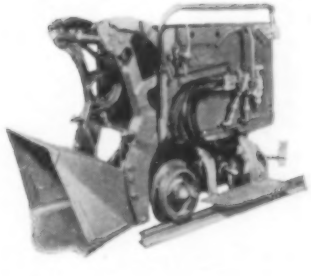
Over 300,000 square feet of complete plant facilities — foundries — steel works — machine shops, equipped with the latest most modern tools now makes this quick shipment a performance fact.

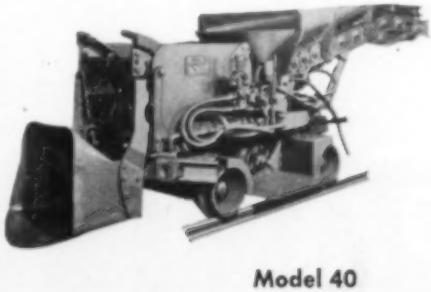
When in Salt Lake City, on your way to or from the American Mining Congress, stop off and visit Eimco's new, modern RockerShovel plant.



Model 12B

Model 21





Model 40

EIMCO

THE EIMCO CORPORATION

The World's Largest Manufacturers of Underground Rock Loading Machines

EXECUTIVE OFFICES AND FACTORIES — SALT LAKE CITY 8, UTAH, U. S. A.

BRANCHES: NEW YORK, CHICAGO, BIRMINGHAM, EL PASO, SACRAMENTO, MANILA

AFFILIATED COMPANIES: SOCIETE EIMCO, PARIS, FRANCE
EIMCO (GREAT BRITAIN) LTD., LEEDS 12, ENGLAND
AGENTS IN ALL PRINCIPAL CITIES THROUGHOUT THE WORLD

BALANCE...

is highly essential in valves, too!

Without proper balance between the design and materials of a valve on the one hand and the requirements of a given service on the other, the operations of an industrial plant can be seriously impaired.

That's why the slogan at Powell has always been "the valve must exactly suit the service."

And the net result of more than a century of following this principle is that today Powell makes a complete line of Bronze and Iron Valves of all necessary types and sizes, especially adapted to meet the requirements of the compressed air services.

Fig. 375 — 200-pound Bronze Gate Valve with screwed ends, inside screw rising stem, union bonnet and renewable, wear-resisting "Powellium" nickel-bronze disc.

Fig. 560—200-pound Bronze Regrinding Horizontal Swing Check Valve. Screwed ends, screwed-on cap and regrindable, renewable bronze disc.

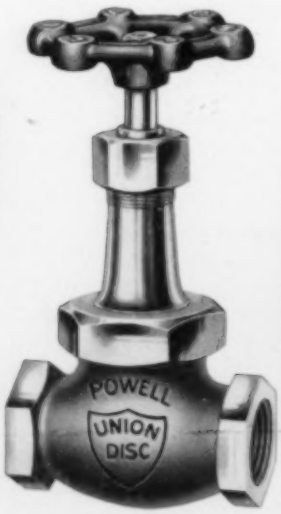


Fig. 150— 150-pound Bronze Globe Valve with screwed ends, union bonnet and renewable composition disc.

Fig. 1793—Large 125-pound Iron Body Bronze Mounted Gate Valve with outside screw rising stem, bolted flanged yoke and tapered solid wedge.

The Wm. Powell Company, Cincinnati 22, Ohio

DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

POWELL VALVES

"Certified" Service

AN ADDED REASON FOR INVESTING IN ALLIS-CHALMERS MOTORS!

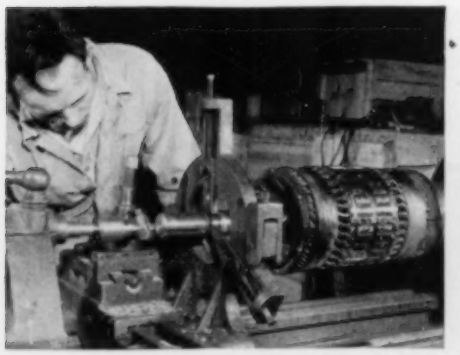
IT MEANS: 1) *Better, Faster Service.* Independent local repair shops are now being selected and authorized to service and repair Allis-Chalmers Motors, Transformers, Controls, Pumps — and "Certify" them as to workmanship.

2) *Finest Parts and Workmanship.* Shops use genuine Allis-Chalmers repair parts — or parts of equal quality; and are given complete service information, including factory procedure and drawings where necessary.

3) *Friendly Service.* Every Allis-Chalmers "Certified" Service Shop has been selected on the basis of its reputation in its community. It's the kind of company you *like* to do business with!

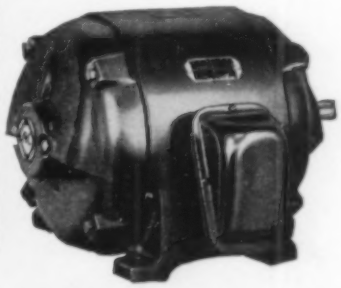
How can you get this service? For the present most "Certified" Service Shops are located in the larger U. S. industrial areas . . . but they're expanding rapidly. Call your nearby A-C District Office or Authorized Dealer for closest recommended shop. ALLIS-CHALMERS, MILWAUKEE 1, WIS.

FINER, FASTER, FRIENDLIER SERVICE FOR INDUSTRY!



The A-C Supply Company of Cuyahoga Falls, Authorized Allis-Chalmers Dealer and newly-appointed "Certified" Service Shop, is staffed and equipped to give prompt, efficient, top-quality repair and service aid to customers in the greater Akron industrial area. Typical of the kind of "Certified" Service organizations being selected throughout U.S.

MANY SIZES, RATINGS OF ALLIS-CHALMERS STANDARD SQUIRREL-CAGE MOTORS ARE NOW AVAILABLE FROM STOCK. CHECK YOUR AUTHORIZED A-C DEALER, OR DISTRICT OFFICE FOR DETAILS.

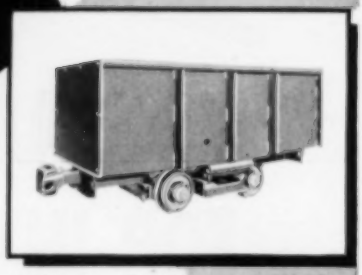


A 2506

ALLIS-CHALMERS

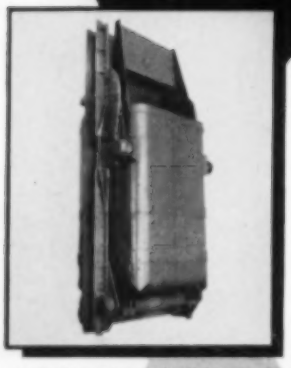
One of the Big 3 in Electric Power Equipment—Biggest of All in Range of Industrial Products

Look TO LAKE SHORE for Leadership



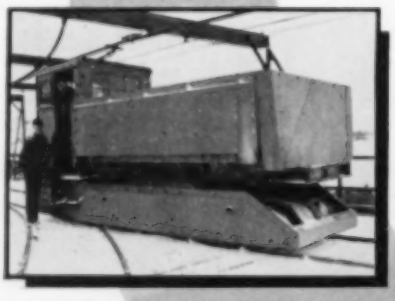
▲ Famous LoHed tram cars for economic hauling of ore and rock. Suitable for all dumping systems.

For seventy-five years Lake Shore Engineering Company has pioneered in the field of custom engineered mining equipment. Our wide experience in engineering and manufacture is available to help you solve your equipment problems. Built by men who know, understand, and live mining, Lake Shore equipment is serving the world. Write today for descriptive catalogs and literature.



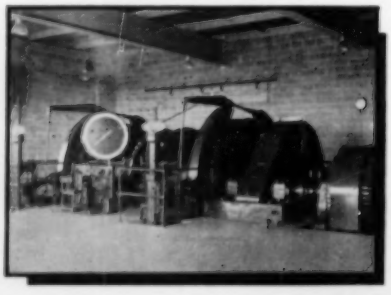
▲ Lake Shore builds steel, aluminum and steel, welded or riveted, skip and cage combinations to suit requirements.

▲ Open, semienclosed and fully enclosed designs of all types cages, steel and aluminum and steel construction.



◀ Three-way or five-way trestle dump cars. Dumps over both sides, end and both corners. A time saver on stockpiling.

Man and material, sinking, sub-level and cargo hoists. All latest improvements for maximum efficiency and safety, engineered to fit any requirement. Sizes to 10-ft. diameter. ▶



▲ Full line of carrying sheaves, rubber lined idler sheaves, split type and rotating shaft head sheaves. Cast iron, plate steel, or plate aluminum construction. Wide range of sizes.

LAKE SHORE
ENGINEERING COMPANY

IRON MOUNTAIN, MICHIGAN
Plants at Iron Mountain and Marquette, Michigan

Export Division
60 East 42nd Street, New York 17, New York
Cable address: LAKESHORE

Eastern Sales Offices
60 East 42nd Street, New York 17, New York
Telephone: MUrray Hill 2-3991

He's Fussy about Rope Lubrication

The Bethlehem wire-rope man has an eagle eye. He can spot a "dry" rope a mile away . . . although he doesn't like to find one, for hard-working wire rope should never be allowed to operate dry—unlubricated—for any length of time.

This is a fundamental too often overlooked. Frequently Bethlehem engineers encounter ropes so dry that serious harm has already resulted. Sometimes—strange as it seems—the user doesn't realize how *vital* lubrication really is. Sometimes he's merely forgotten—or meant to take the proper steps but got too busy.

For best results and longest life, wire rope must be lubricated. Why? Because lubrication reduces internal friction—the friction of wire against wire. Because it reduces the friction of rope against sheaves, rope against drum. Because—important!—it helps prevent destructive rust from getting a start.

True, in some services, the original factory lubrication provides adequate protection throughout the useful life of the rope. But this is not *always* the case. So, when a Bethlehem man comes to check your ropes, lubrication is one of the first things he'll look into. It's his business to see that you get the correct wire ropes for your job—but he also wants you to *get the most out of them.* Proper lubrication is a long step in this direction.

If you need advice on this or any other wire-rope problem, call for a Bethlehem engineer. He's part of a nation-wide network whose services are always available.

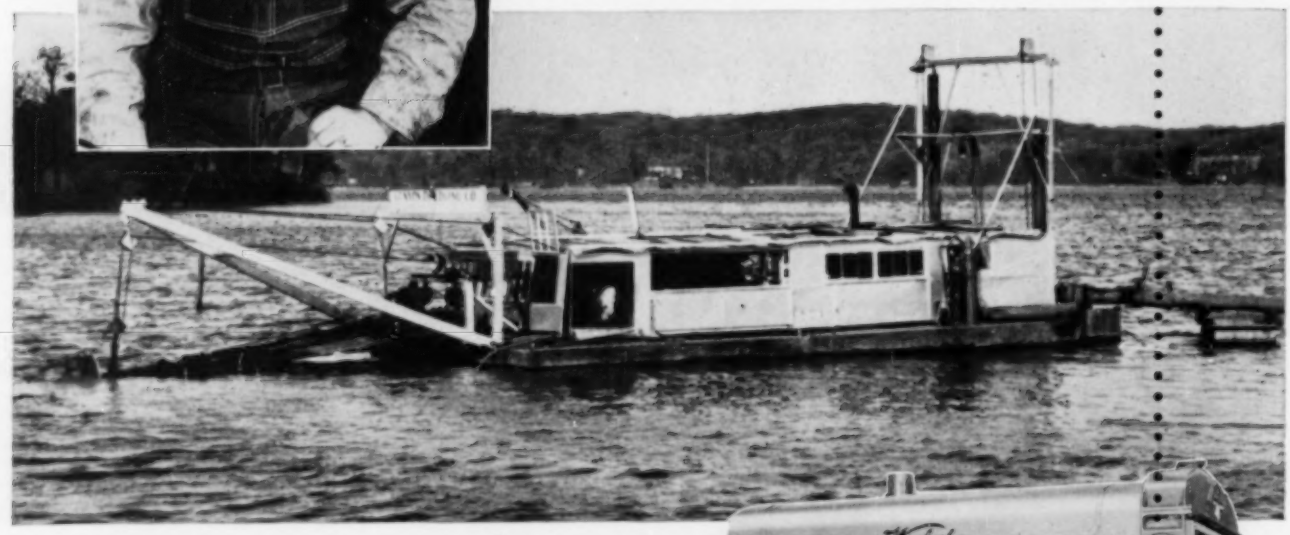
BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by
Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

When you think WIRE ROPE . . . think BETHLEHEM

MAKING A MARSH INTO MONEY

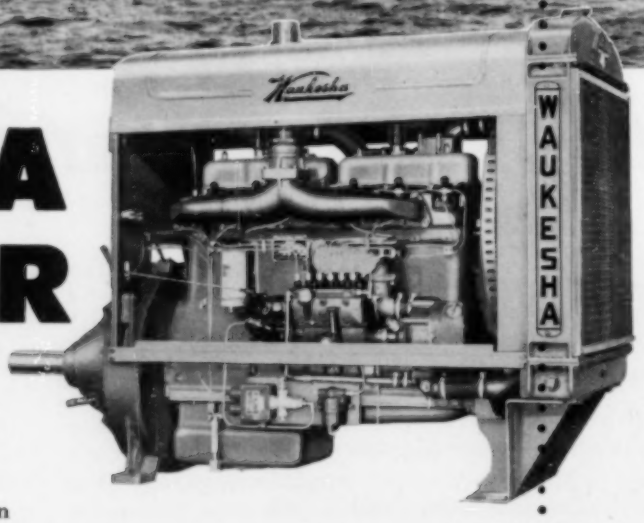
...with a Diesel driven dredge



WAUKESHA *Diesel* POWER

Model 148-DKU

Six cylinders, 5¼ in. bore x 6 in. stroke; 779 cu. in. displacement



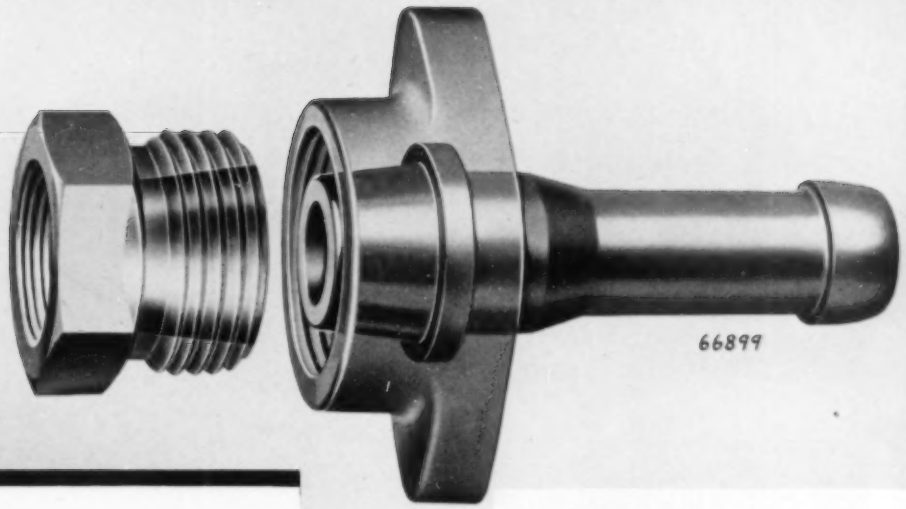
Mr. VILBERT GUNYON looks pleased. Mr. Gunyon *is* pleased—with the way this dredge is filling in acreage on the shores of Lake Geneva, Wis. It is rapidly converting a marsh into resort property that is worth a million dollars or more.

The dredge is owned by the Gunyon Dredging Co., Elkhorn, Wis. It is the sand sucking type, and a 148-DKU Waukesha Diesel Power Unit drives both the pump and the cutter head. Mr. Gunyon is particularly pleased with this Waukesha Diesel. He thinks it's the best engine that he has ever run.

Installed in the dredge in the spring of 1946, this is one of the pilot models of the 148-DKU Waukesha Diesel. The unit in the picture shows the perfected design of the 148-DKU Diesel. It runs at full capacity with a remarkably clean exhaust. You'll be pleased, too, with a Diesel like this. It has a 7-bearing crankshaft with crankpins and main bearings hardened to 600 Brinell. Removable wet sleeve cylinders, hardened to 400 Brinell. Chrome silicon alloy intake and exhaust valves; both valve seats are Stellite inserts. 24-volt electric starting system. Why not find out all about it? Send for Bulletin 1414.

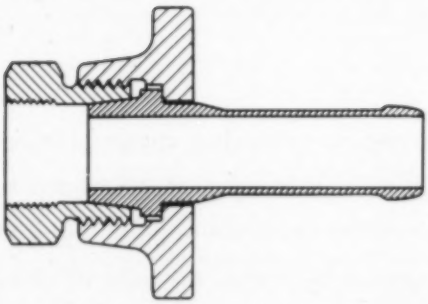
WAUKESHA MOTOR COMPANY • WAUKESHA, WIS. • NEW YORK • TULSA • LOS ANGELES

A *New* ROCK DRILL HOSE COUPLING



The DHC Hose Coupling is available from ½ inch to 1¼ inch sizes and will fit any rock drill.

DHC



Here at last is a hose coupling that all Rock Drill men have been looking for. It has four outstanding operating advantages. It is SAFE, it is DURABLE, it is LEAKPROOF, and it REQUIRES NO GASKET.

The secret of the success of this DHC hose coupling lies in its taper-joint construction. The taper provides an absolute seal. There can be no leakage to offset high compressor and rock drill efficiency. Moreover, the joint locks in such a way when the wing nut is drawn up that the two parts become one rigid piece. This makes the coupling vibration-proof and provides great safety

For further details, contact the Ingersoll-Rand branch office nearest you. Write or ask for bulletin No. 4031. Better yet, try these hose couplings on your job. You will find them the safest, most leakproof, most durable, and most trouble-free couplings on the market today.

Ingersoll-Rand

11 Broadway, New York 4, N. Y.

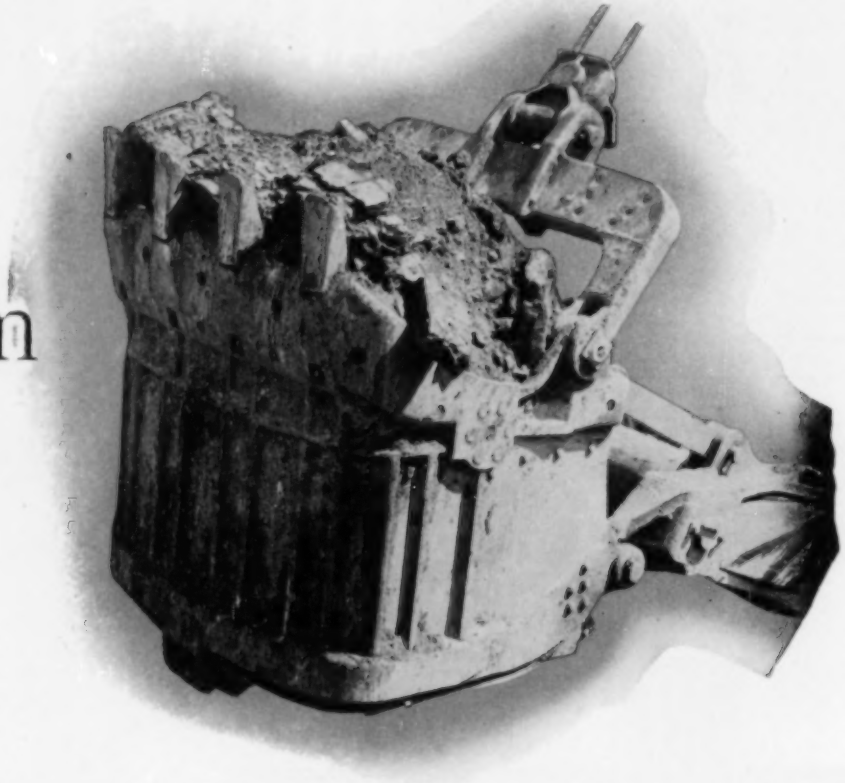
5-529

COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO BLOWERS • CONDENSERS • CENTRIFUGAL PUMPS • OIL AND GAS ENGINES

HEAP 'EM HIGH

and

Swing 'em Quick



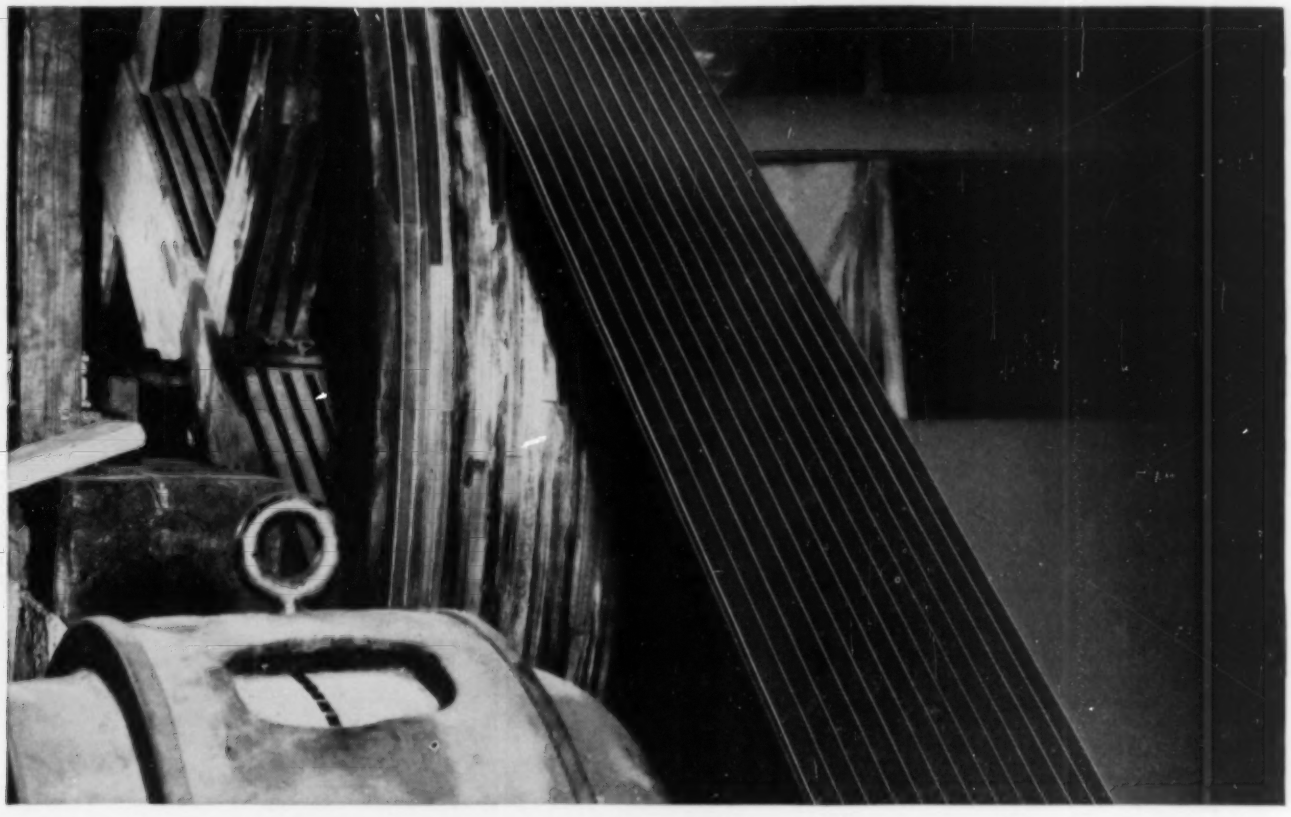
BUCYRUS ERIE

You can fill the dipper full with a Bucyrus-Erie shovel because the machine's long effective upper boom section, big sheaves, and single-part hoist concentrate maximum digging force at the dipper teeth . . . because the dipper teeth and sharp cutting edge are set at just the right angle for easy penetration . . . because the position of the bail allows heaping loads to flow in easily . . . because the dipper's long front, short back, and curved door mean easy filling of corners and back.

You can swing these big dipper loads fast with a Bucyrus-Erie because advanced boom design provides exceptionally light weight but at no expense to strong practical construction . . . because the swing motors, with low WR^2, provide fast acceleration and deceleration . . . because operating reactions are finely blended for smooth accurate control.

Heaping dippers high and swinging them quickly means bigger output at lower cost with Bucyrus-Erie shovels.

Bucyrus-Erie Company SO. MILWAUKEE WISCONSIN



Saves $1,200 a year on "Crack-the-Whip" Drive

"Cracking the Whip" is fun for the riders of a Pennsylvania Amusement Park, but it's one of the toughest drive applications. The fast starts, rapid accelerations and sudden stops cause ordinary belts to slip . . . burn and wear through.

Take the case of this Park Owner. During the 1946 park season, his "Whip" wore out 3 of the 40-foot, original-type belts. He had to replace them at a cost of $400 each.

Then he called the Dayton V-Belt Distributor. His problem was studied. The power, speed and space limitation analyzed. Recommendation: Use the old wood—flat driven pulley, install standard Dayton V-Belts and Dayton Motor V-Pulleys. Nothing "special" required. Result: After two years, no slippage, no burning, no wear through. $1,200 a year saved.

When it comes to transmitting power, Daytons can do it better and save you money. Your local Dayton V-Belt Distributor has specialized knowledge and complete stocks.

For a better, more profitable solution to your drive problem, call your local Dayton V-Belt Distributor.

THE DAYTON RUBBER COMPANY

Main Office and Factory: Dayton 1, Ohio

Branch Offices: Atlanta, Boston, Chicago, Cleveland, Dallas, Detroit, Los Angeles, Minneapolis, New York, Philadelphia, St. Louis

V-Belt Buyers! A leading mill supply house near you offers specialized Dayton V-Belt service. Look for the name under the trade name heading "Dayton V-Belts" in the yellow pages of your telephone directory.

Dayton Rubber

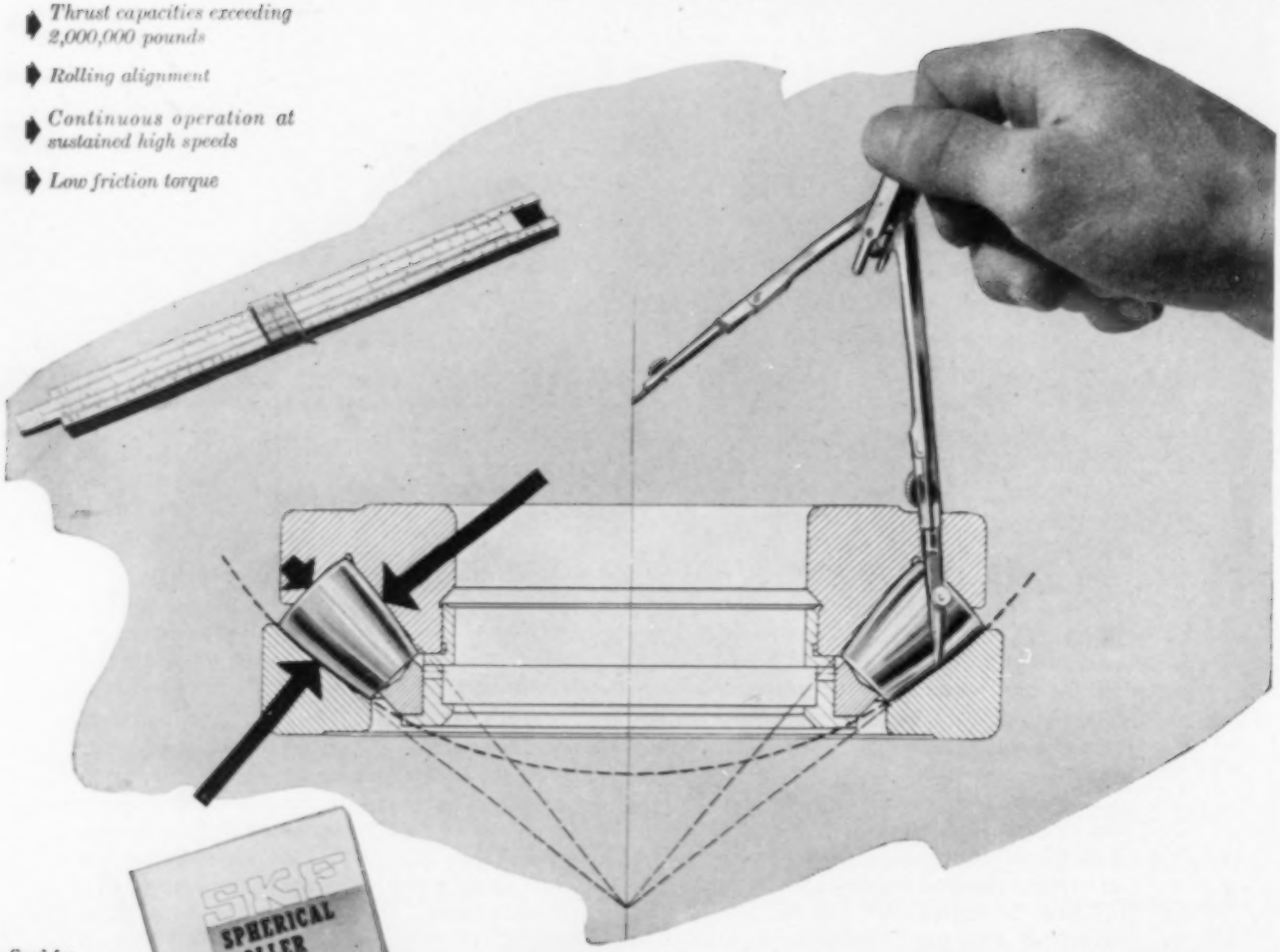
THE MARK OF TECHNICAL EXCELLENCE IN NATURAL AND SYNTHETIC RUBBER

ENGINEERED BY SKF TO CARRY

HEAVY THRUST LOADS

at high speeds!

- *Thrust capacities exceeding 2,000,000 pounds*
- *Rolling alignment*
- *Continuous operation at sustained high speeds*
- *Low friction torque*



Send for CAT. 279

The SKF Spherical Roller Thrust Bearing is designed to carry heavy thrust loads at sustained high speeds. This high capacity is not reduced by misalignment between shaft and housing bore, since the outer race of the bearing is a section of a sphere on which the inner race and spherical roller assembly align freely.

The rollers are so shaped that load components firmly contact the roller ends against the unusually high guide flange. This assures positive guiding of the rollers without excessive pressure on the roller ends.

The bearing is so constructed that oil is pumped outwardly between the rollers, bathing all parts of the bearing in lubricant. 6454

SKF INDUSTRIES, INC., PHILA. 32, PA.

Durasheath

THE ALL-PURPOSE CABLE

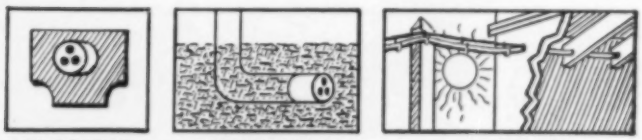
built for those TOUGH JOBS!

Small sizes or large . . . one, two or three conductors . . . moisture-resisting insulation . . . from 0 to 5,000 volts . . . Durasheath is built for rugged service:

Durasheath offers high tensile strength and resistance to impact and abrasion—*plus* extreme flexibility that makes it easier to handle. Also, Durasheath resists moisture, acids and alkalies generally found in the soil, eliminates problems of electrolysis, corrosion and extremes in temperature and is highly resistant to flame—making it possible to use a single type and size of cable in runs that are partly aerial, partly underground or in conduit.

For complete information, write for Publication C-27.

48450



IN CONDUIT ...UNDERGROUND ..IN THE AIR

Anacondaloy®-coated copper conductors are insulated with a moisture-resisting synthetic rubber compound, bound with color-coded rubber-filled tape and enclosed in a tough, high mechanical strength, moisture and flame-resistant outer jacket of Neoprene. Conductors have the lasting protection of a solid block of synthetic rubber and Neoprene.

®Reg. U. S. Pat. Off.

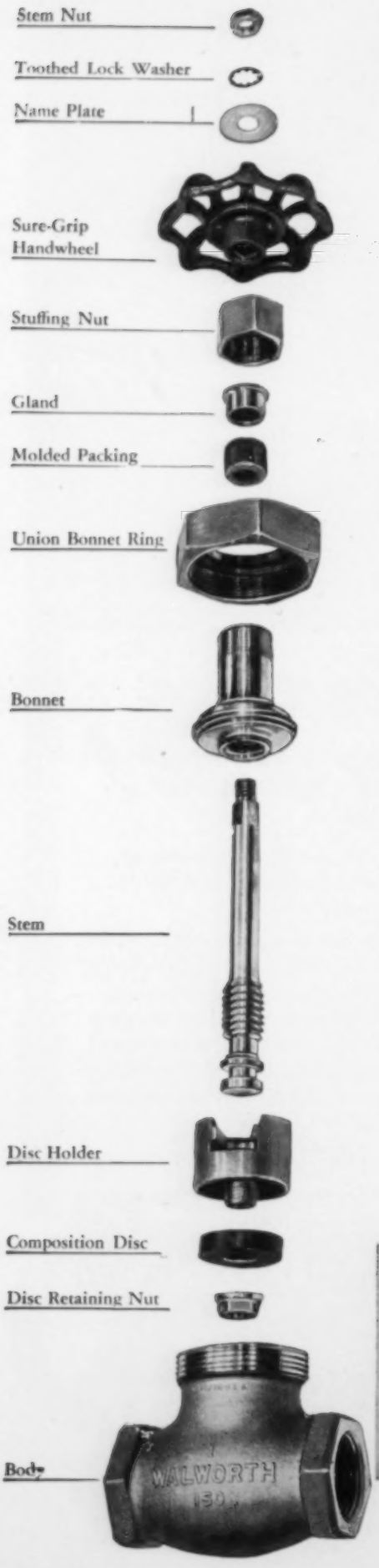
Durasheath

AN *Anaconda* PRODUCT

ANACONDA from mine to consumer

ANACONDA WIRE AND CABLE COMPANY

25 Broadway, New York 4, N. Y.



TO MAKE A GOOD VALVE BETTER

Walworth has redesigned and improved its No. 95 Quality Bronze Globe Valve.

150 pounds working steam pressure at 500F

300 pounds cold water, oil, or gas.

Can be repacked under pressure when fully opened.

The Walworth No. 95 Bronze Globe Valve has always been tops with piping men because they liked these features: Renewable composition disc; lock-on, slip-off disc holder; union bonnet construction; deep stuffing box; tough bronze body made of Composition M (ASTM B61).

Now Walworth has added these improvements: (1) New cylindrical disc holder that accurately guides the disc to the seat, regardless of the position in which you install the valve. (2) Newly designed, air-cooled, sure-grip handwheel that you can grab and turn, even when wearing greasy work gloves. It has a tapered square hole sized to gage to fit snugly on the finished square of the stem. (3) Toothed lock-washer to prevent the stem nut from becoming loose. (4) All parts have been redesigned to give maximum service and strength.

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ON THE COVER

OUR cover picture, which shows one of the numerous spectacular peaks in Banff National Park, Canada, seems appropriate in this holiday season. This Rocky Mountain area was the nucleus around which the Dominion's extensive park system has grown. Early explorers told of two large hot springs in the section, but they were not brought to public attention until the Canadian Pacific Railway was built through the mountains in 1883. Soon afterward the government set aside an area of 10 square miles around the springs as a tourist and recreation preserve. It was subsequently enlarged to 2585 square miles. It includes famed Lake Louise, 40 miles to the west of the town of Banff. The entire region is recognized as one of the world's most magnificent mountain playgrounds. The photograph is reproduced by courtesy of National Parks Bureau, Canada.

•

IN THIS ISSUE

A COMBINATION of favorable circumstances enables the Scrub Oaks Mine near Dover, N. J., to sell all the rock it excavates in opening up its iron deposits, as well as that which is culled from the low-grade magnetite during its concentration. The additional revenue derived from this by-product business makes it possible to operate a property that would otherwise have to be closed down. Details are given in our leading article.

•

THE average 3-story dwelling could be placed inside the tunnel recently driven in Montana to carry the South Fork of the Flathead River around the site where Hungry Horse Dam will be reared. Although the bore is far short of record size, its excavation was an interesting engineering job. Page 184.

•

INSTEAD of erecting conventional low-pressure holders for the storage of natural gas to meet consumer demand, the Public Service Company of Northern Illinois is putting the fuel underground in connected pipe sections at a pressure of 2240 psi. Indicated construction costs favor the new method by a four or five to one ratio, and it has other advantages that may lead to its widespread adoption. Page 187.

•

HOW sloping highway embankments are stabilized by boring horizontal drainage holes in them is told on page 191. Another short article (page 193) describes two pneumatic methods used in Arizona to protect irrigation ditches from the damaging effects of weeds and gophers. *When the Buffaloes Roamed* tells why and how early pothunters all but exterminated the American bison.

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C. H. VIVIAN, *Editor* J. W. YOUNG, *Director of Advertising*
ANNA M. HOFFMANN, *Associate Editor* J. J. KATARBA, *Advertising Mgr.*
A. W. LOOMIS, *Assistant Editor* JOSEPH C. DILTS, *Advertising Sales*
WALTER P. GILLINGHAM, *Assistant Editor*
D. Y. MARSHALL, *Europe*, 243 Upper Thames St., London, E.C.4.
F. A. McLEAN, *Canada*, New Birks Building, Montreal, Quebec.

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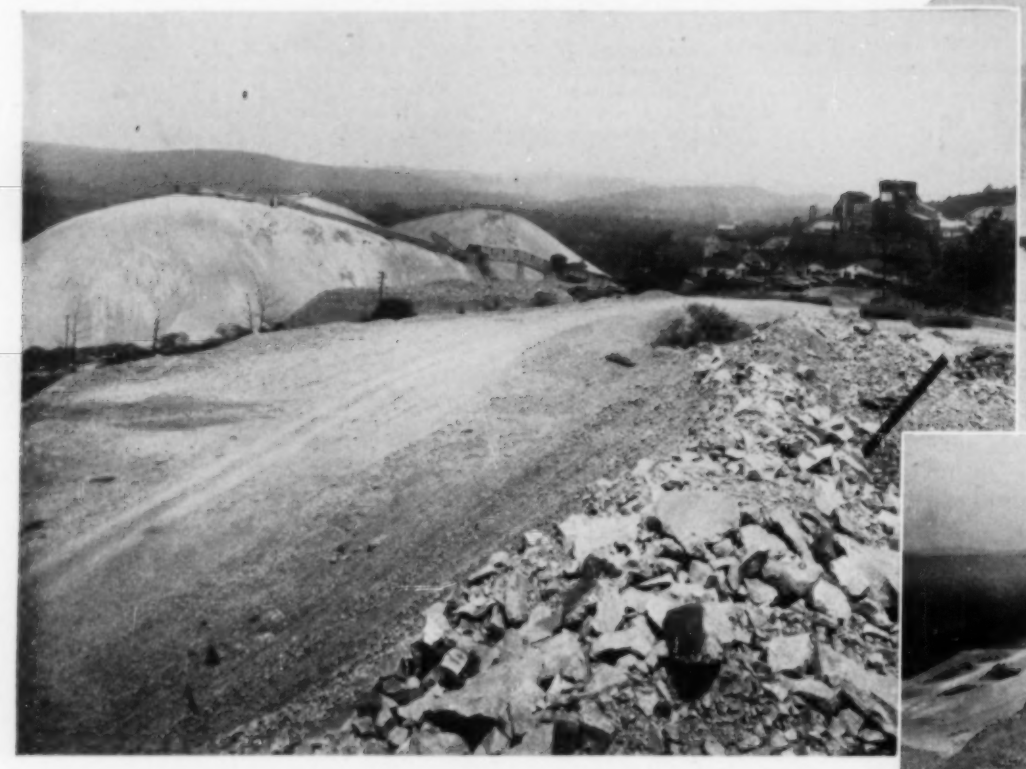
A Mine with a By-Product Business

The Scrub Oaks in Northern New Jersey Sells All the Materials It Hoists

C. H. Vivian



SCRUB OAKS MINE

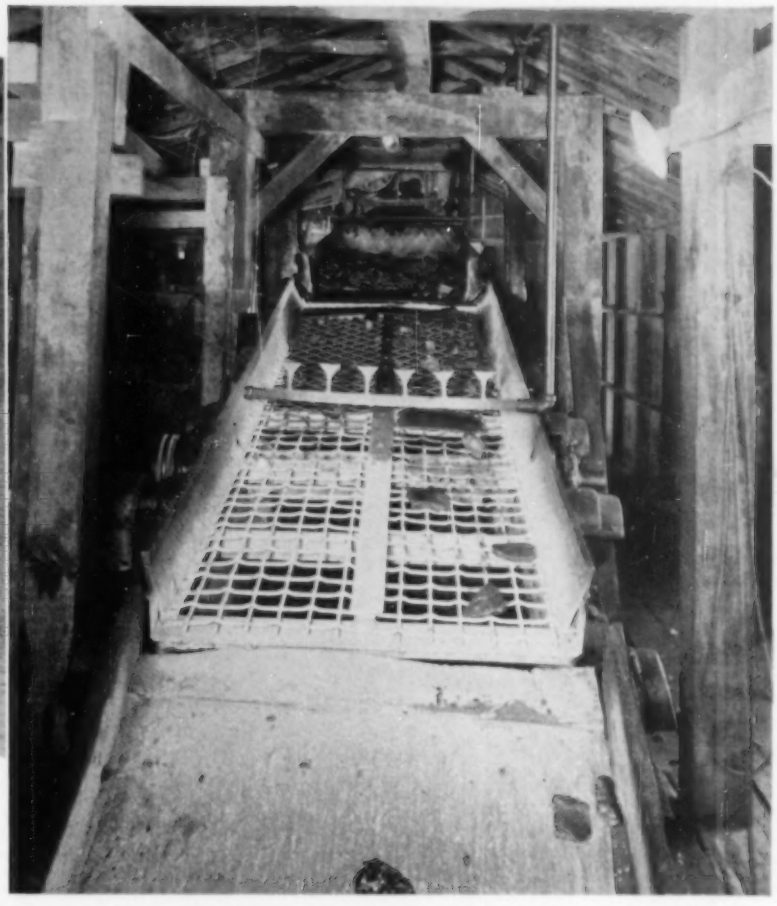
Opened 92 years ago, this New Jersey property was worked only intermittently until the sale of by-product stone began to augment the revenue from the low-grade magnetite ore. Today the mine employs 350 men and seeks more. The picture was taken from the waste-rock dump built up in former years and now being drawn upon to supplement the material currently hoisted. Sand is in less demand than stone, and the mound at the left contains three million tons of it.

FEW metal mines are fortunate enough to dispose profitably of the rock that they necessarily extract from the earth in huge quantities in order to obtain the wanted elements it contains. In some instances, a percentage of the extraneous material is sent back underground to fill worked-out spaces, but this costs money instead of bringing it in. Occasionally, a mine sells waste rock for roadbuilding or construction purposes, but this is ordinarily done on a small and local scale because mines are seldom within economical transportation distance of heavily populated sections. The average mine has no alternative but to pile up its nonmetallic gleanings, and even this becomes increasingly expensive as the dumps creep farther away from the shaft house.

An exception to the general rule is the Scrub Oaks Mine near Dover, N. J., which sells virtually every ounce of material it hoists to the surface, whether ore or rock. In fact, it does even better than that, for it is currently marketing waste rock from dumps that were built up in past years. About the only part of its output that doesn't yield a revenue is the negligible quantity of dust that escapes to the atmosphere during the process of reducing the rock to the various sizes in which it is sold.

The mine, which yields iron ore, is owned by the Alan Wood Steel Company of Conshohocken, Pa. It is located on the New Jersey magnetite belt that extends for 25 miles from Oxford to Mount Hope. The ore is classed as lean, with an iron content of 30 percent or less, and can be produced profitably only when economic conditions are favorable. This has given the mine a spotty record of activity, and the management states that it would not be operating profitably at present if it were not for the by-product stone business that has been developed.

Following its opening in 1856, the Scrub Oaks was worked for only five years, and then lay idle until 1917 when it was reopened to help meet the war-time demand for iron ore. That period of production lasted until 1922, when the owner, Warren Foundry & Pipe Corporation, closed the mine. The Alan Wood interests leased the property in 1930 and operated it intermittently until 1934, meanwhile rebuilding the concentrating mill. A rising demand for iron ore in 1934



IN THE SCREENING HOUSE

Following crushing, stone is sized on an oscillating screen, as shown. Jets of water at the upper end wash the material as it is fed to the screen. Here 2½-inch stone is being produced. The oversize passes over the near end and is returned to the crusher.

STORAGE PILES

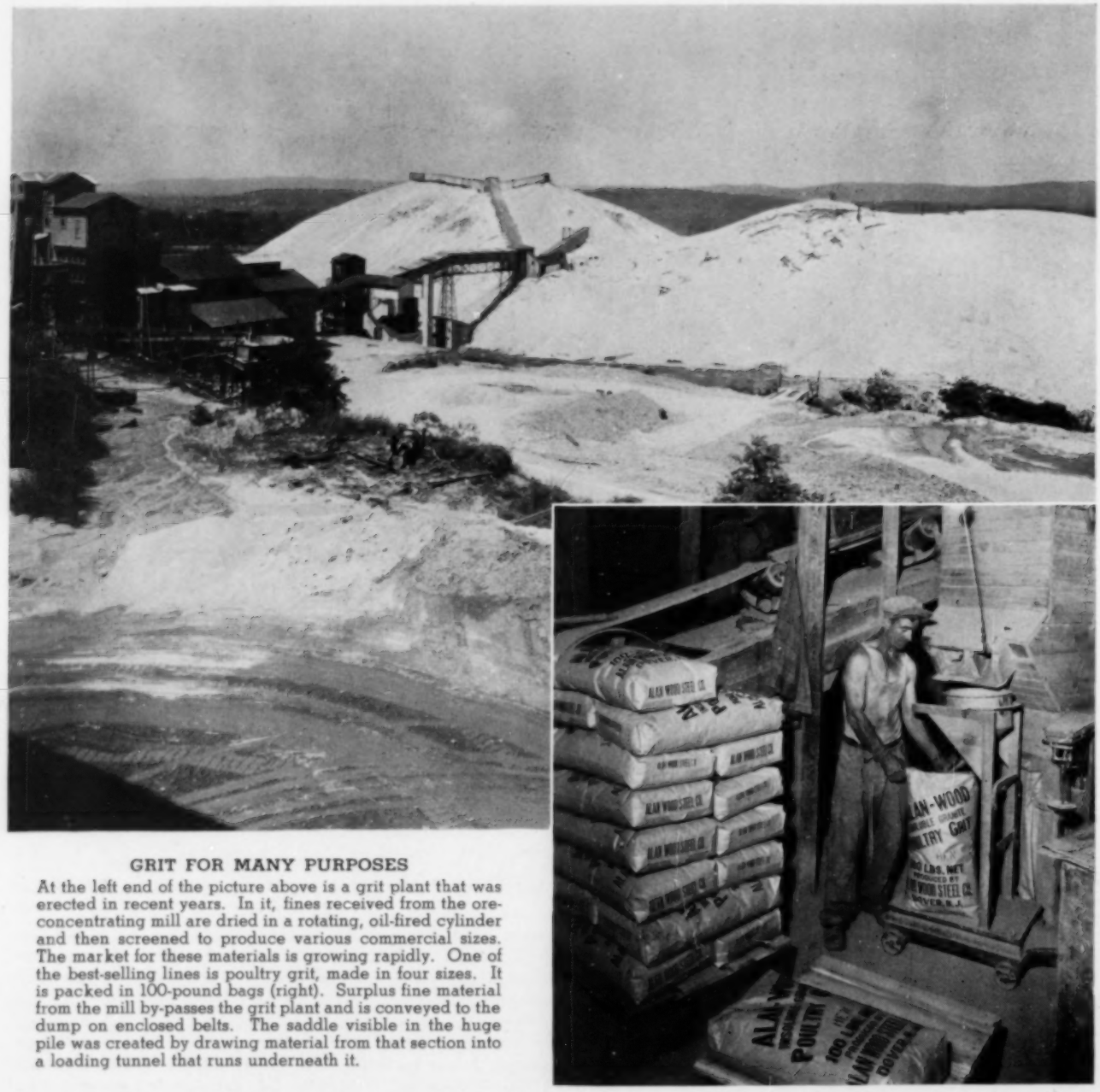
Directly above is a general view of the stockpiles of stone that were built up in the winter months to meet the heavy demands during fair weather. The structure in the middleground is a screening plant where material drawn from the dumps accumulated in past years is sized after being crushed. The daily output of stone in this plant and the ore-concentrating mill combined runs around 900 tons in the summer time. The largest-selling size of the five produced is the ⅜-inch. At the top is shown a truck being loaded with 7½ tons of stone in two minutes. Revolving blades at the bottom rear of the gasoline engine-powered loader move the material from either side toward an elevator bucket line in the center.

caused an increase in activity, and by 1936 operations were at near capacity. Production has been steady since then, and was especially strong during the World War II years. Alan Wood purchased the Scrub Oaks in 1941. As regards number of employees and tonnage of ore hoisted, it is the largest of the New Jersey magnetite mines. It can be made to yield annually 600,000 tons of ore that will provide 250,000 tons of concentrate containing 67 to 70 percent of iron. It is currently employing 350 men.

The by-product stone business was initiated even before the present owners took over. Prior to 1930, Warren Foundry & Pipe Corporation leased the stone and sand privileges to Gallow Bros., a firm dealing in those materials. It began crushing the nonore-bearing rock obtained as a result of development work in the mine, and at the same time built a concrete tunnel under a site where tailings from the mill were to be deposited so that the material might be quickly and inexpensively loaded into cars for delivery to customers.

Following this example, Alan Wood entered the business in 1934, producing mainly stone for concrete aggregates. Since then it has extended the range to include various sizes of stone, grit, and sand. In addition, some run-of-mine rock is sold without crushing or screening for use in roadbuilding where material excavated from cuts is insufficient to meet fill requirements. The demand varies in the course of a year, being heaviest when weather conditions are favorable for highway and general construction. In some months, sales run as high as 50,000 tons.

Circumstances that favor this side line are the character of the product and the geographical location of the mine. The country rock in which the ore occurs is of acceptable quality for many purposes, being fine-grained granite and gneiss of good strength and high resistance to deterioration by weathering. Scrub Oaks is close to one of the most densely settled regions in the country, with the New York and New Jersey metropolitan area only about an hour away by truck. Within a radius of 50 miles, millions of dollars are spent annually for highways and buildings, both large consumers of stone and sand. The mine is but a short distance from a main concrete thoroughfare, and the access road is open the year round.



GRIT FOR MANY PURPOSES

At the left end of the picture above is a grit plant that was erected in recent years. In it, fines received from the ore-concentrating mill are dried in a rotating, oil-fired cylinder and then screened to produce various commercial sizes. The market for these materials is growing rapidly. One of the best-selling lines is poultry grit, made in four sizes. It is packed in 100-pound bags (right). Surplus fine material from the mill by-passes the grit plant and is conveyed to the dump on enclosed belts. The saddle visible in the huge pile was created by drawing material from that section into a loading tunnel that runs underneath it.

A considerable proportion of the output is crushed and screened to size in the course of the milling operations and has only to be hauled away. In the process of recovering the magnetite, the ore is reduced in stages, and after each crushing is run over magnetic separators that take out the magnetite. The rejected stone is already graded into five sizes ranging from 2½ inches to ¼ inch. Some of the iron in the mine is in the form of martite, which is similar to magnetite in composition but is nonmagnetic. This is recovered by grinding the ore in ball and rod mills and passing the finely divided material over Wilfley concentrating tables. The reject is sand, which is graded into various commercial sizes by screening.

The remainder of the stone is obtained by crushing and screening rock or ore that is too lean in iron to warrant milling. Most of the raw material comes from the development drifts and other mine openings that are made to give access to the ore. In the Scrub Oaks, all such passageways are driven outside of the ore bodies, and if it were not for the by-product stone business the material drilled, blasted, and hoisted at great expense would be sheer waste. Upon reaching the surface, it would be necessary to transport it to dumps at additional cost.

The material is run through a crushing plant provided especially for that purpose. It contains one gyratory and one cone-type crusher, which are operated either separately or in series, depending upon the degree of reduction desired. The crushed stone is elevated by a conveyor belt to a screening house, where it is separated into the various commercial sizes by oscillating screens. It is washed with jets of water just prior to screening. During periods of the year when the rock from current mining operations does not suffice to meet requirements, raw material is drawn from the old waste dumps and reduced, as desired, in the crushing plant just mentioned.

The products of this plant are loaded by gravity into trucks that haul them either to customers or to open stock piles. The latter are built up during periods when the demand for stone is light and are drawn upon as needed to fill orders during the fair-weather months when roadbuilding and general

construction are at their peak. From the piles, the material is dumped into trucks either by a crane-operated clamshell bucket or by a bucket-type elevator.

The various sizes of stone produced in the concentrating mill are loaded by gravity chutes into trucks which, similarly, deliver them to users or to the stock piles. The sand obtained in the mill takes any one of three routes: it is discharged directly into trucks and handled like the stone; is conveyed to a grit-processing plant that has been built adjacent to the mill; or is carried by belt to a dump under which runs the concrete tunnel that was constructed by Gallow Bros. when that firm had the by-product concession at the mine. This passageway has overhead gates at intervals of a few yards, and these can be opened to feed sand onto a conveyor belt that transports it either to railroad cars or trucks. By this system a 60-ton car can be loaded in eighteen minutes. On an average, every 50,000 tons of ore hoisted produces around 33,000 tons of stone, and the remainder is shipped as iron concentrate.

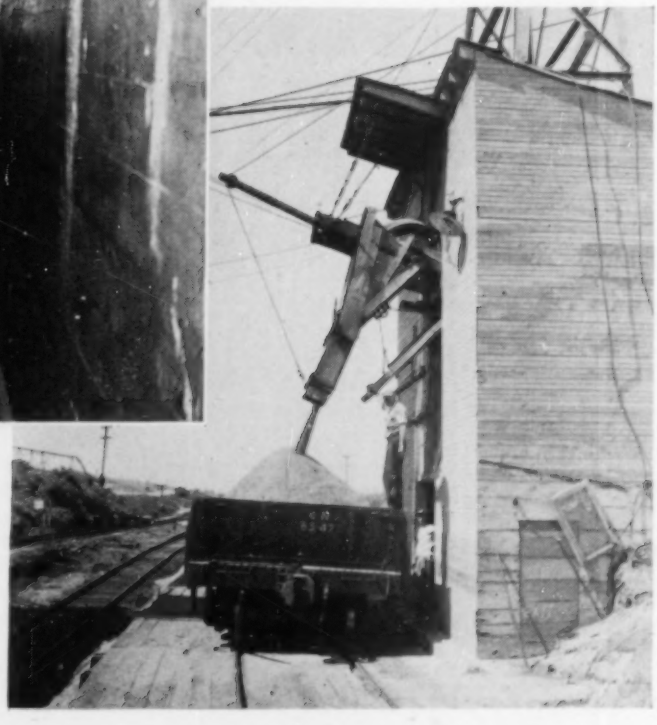
Most of the rock and much of the sand is used for making concrete for highway and general construction. Sand is also used in asphalt roads. The highway departments of New Jersey, New York, and Pennsylvania have rigid specifications covering sand for roadbuilding, and Scrub Oaks turns out material to meet them. Whenever the company is bidding on a contract to furnish sand for this purpose in New Jersey, the state sends an inspector to the mine to check the material offered. In the case of the other states, samples are sent to the respective highway departments for testing. Asphalt sand has a larger percentage of fines in it than is permissible in sand for concrete. In addition to the stone that enters into concrete mixes, some of 2½-inch size is used to form bases for concrete or penetration-type highways. Contractors also buy unclassified fines from the crushing plant to mix with clay for shoulders of hard-surfaced roads.

Various sizes of fines are marketed under the classification of grit. One of these, known as New Jersey grit in which the particles average about ¼ inch, is shipped to a quarry which adds it to material of its own and sells the product for use in asphalt mixtures. This grit differs from others produced at the mine in that it contains no fines. Another grit of a specified size is intended expressly for spreading on icy roads in wintertime. The New Jersey Highway Department is the sole customer for this material, which is distributed in the summertime and stored in piles throughout the state's roadway system so as to be handy when needed.

In recent years, there has been a rising demand for grit by poultry raisers. This is made in four sizes classified as chick, pullet, hen, and turkey grit and is packed in 100-pound bags for shipment. The light reflected by the bits of feldspar and mica contained in the sand attracts the birds, a property that makes the material desirable for use in poultry yards. An extra-fine grade of grit is provided for canaries.

Sand of various sizes for special purposes is also available. What is known as engine sand is bought by railroads for sanding rails to improve traction when starting heavy trains or negotiating steep grades. A new market is developing for the material as more and more trucks are being equipped with appliances for feeding sand under the wheels when roads are icy. Then there is a type of sand furnished to a company that makes concrete pipe by a spinning process. The finest grade, containing particles ranging down to minus 200 mesh and designated as beach sand, is sold to fertilizer manufacturers as a mineral base for their products.

All in all, the by-product business at Scrub Oaks has become an important, even an indispensable, contributor to the mine's financial success. On any working day during fair weather there is a fairly steady procession of trucks moving in, loading, and departing and, in addition, large quantities of material are transported by rail. Shipments are made as far as Elmira, N. Y., and Harrisburg, Pa., both more than 125 miles away.



LOADING THREE TONS OF SAND A MINUTE

Sand fed by gravity through overhead gates travels on an 18-inch conveyor belt in a concrete tunnel to railroad cars or trucks at its portal. Free flow through the gates is promoted by sluicing the material down from the top of the pile with high-pressure water streams. Sand graded to meet various specifications can be obtained by drawing from different sections of the pile. The delivery end of the conveyor is shown at the right. A 60-ton car can be loaded in eighteen minutes.

Hungry Horse Diversion Tunnel

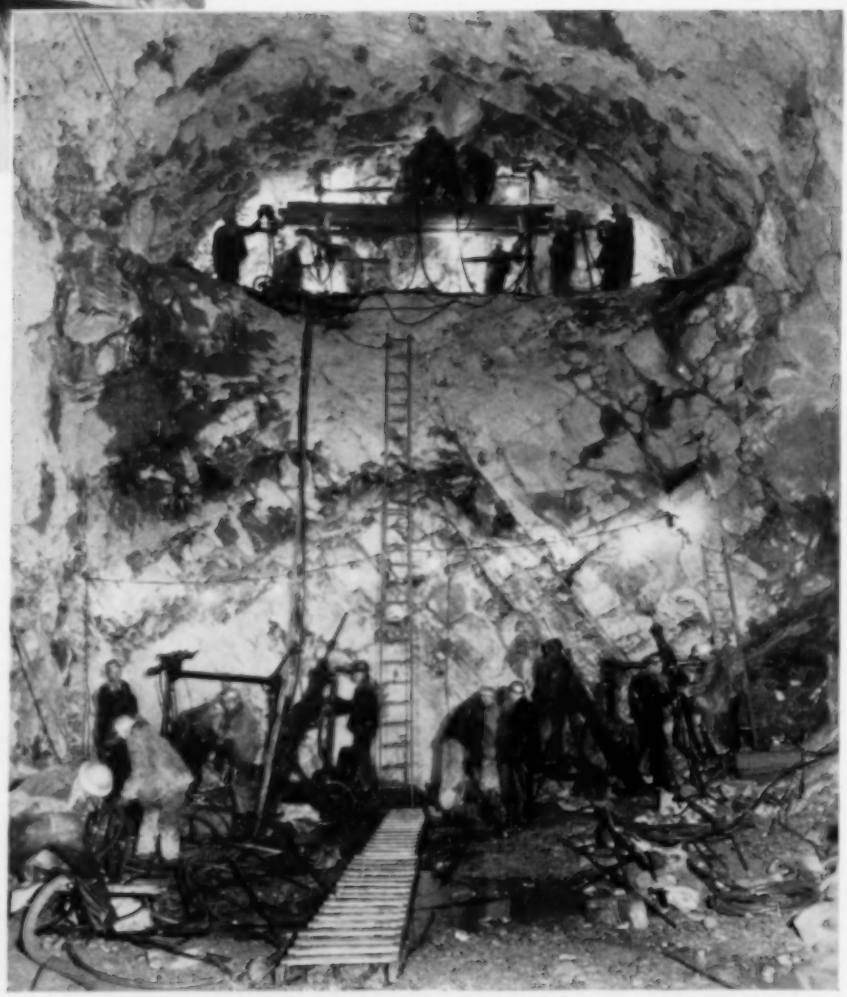
*Carl Walter**

IN A BEAUTIFUL wilderness area of scenic northwestern Montana, work is being started on the construction of the Bureau of Reclamation's Hungry Horse Dam, a name taken from that of a nearby creek. When completed in 1953, it will be the fifth highest dam of any type and the fourth largest in point of mass among concrete dams. Of arch design, it will rise 520 feet above the lowest foundation rock and have a crest length of more than 2000 feet. With associate structures, it will contain approximately 2,900,000 cubic yards of concrete, entailing the use of some 2,500,000 barrels of cement.

The dam site is on the south fork of the Flathead River within 10 miles of the boundary of Glacier National Park and about 25 miles northeast of Kalispell, Mont. The structure will create a reservoir with a capacity of 3,500,000 acre feet and provide storage water to operate four 75,000-kw. turbine-generators to be installed in a powerhouse at the downstream toe. The energy developed there will be integrated with that delivered from Kerr, Bonneville, and Grand Coulee dams and help to alleviate the present shortage of electricity in the Northwest.

A $43,431,000 contract for building the dam and power plant was let on April 21 to a combination of three western firms: General Construction Company, of Seattle, Wash.; The Shea Company, of Alhambra, Calif.; and Morrison-Knudsen Company, Inc., of Boise, Idaho. Except for the Hoover Dam contract, it is the largest single monetary award ever made by the Bureau of Reclamation. However, before the main contract was let, considerable preliminary work was put underway. This included the building of an 8-mile access road, the construction of a camp for the government engineering staff, and the driving of a diversion tunnel to carry the river around the dam site while the structure is being reared.

*Safety Engineer, Guy F. Atkinson Company



HEADING IN 36-FOOT BORE

In the 10-foot-high top heading, six DA-30 power-feed drifters are shown working from columns and bars. At the base of the 26-foot bench are three X-71 drifters on wagon mountings, with a DA-30 operating from an arm attached to each wagon frame. Two J-50 Jackhamers laid on plank ramps are putting in lifter holes. One of the DA-30's in the top heading is pictured at the upper-left and shows how the overhead working platform was supported on the column-and-bar framework, which also served as mountings for the drills.

The diversion tunnel was excavated under contract by Guy F. Atkinson Company, of San Francisco, Calif. It runs through Lion Hill, which will form the east or right abutment of the dam. The bore is 1172 feet long and of horseshoe-shaped section, 36 feet in maximum diameter. This is much larger than a double-track railroad tunnel and exceeds in size the 2-lane subaqueous vehicular tubes in some of our cities. Nevertheless, it is still far short of the record 56-foot diversion tunnels driven at Hoover Dam in 1931.

Operations at the downstream portal were begun in November, 1947, and the first underground heading was established on January 6 of this year. The tunnel was holed through on April 28, having been advanced entirely from the lower portal. Considering that special problems are always involved in driving a bore of this size and that some adverse conditions were encountered, the rate of

progress was deemed very satisfactory. It reflects credit on the engineering staff and operating personnel concerned.

The formation penetrated is the Belt series of the Siyeh limestone of pre-Cambrian age. It is a siliceous dolomite characterized by extremely frequent fractures and joints, scarcely a cubic foot being without some sort of break. In addition, there are numerous large clay seams or "mud slips." Difficulties arising from these structural conditions manifested themselves almost immediately after excavation for a tunneling face was begun. As a result, much more material had to be removed than was anticipated in order to obtain a satisfactory slope at the portal for going underground.

The top heading-and-bench method of tunneling was followed, and no drill carriage or "jumbo" was utilized. Because of the large face, it was planned to advance by means of three levels: a top heading and two graduated benches. However, after careful study of the rock, it was decided that operations could be conducted with a 10-foot top heading and one 26-foot bench. When put into effect, this plan succeeded remarkably well. Although the formation varied in some respects, the characteristic fractures and joints persisted throughout the length of the tunnel.

Drilling in the top heading was done with six Ingersoll-Rand DA-30 drifters mounted on columns and bars. Other bars extending from the same columns supported a platform on which the miners worked when putting in the top holes. The bench was driven by drilling horizontal holes from the tunnel floor. Ordinarily, two X-71 drifters on wagon mountings were employed, and a third unit was sometimes added. Besides the X-71, each rig carried a DA-30 drill attached to the wagon uprights by means of a horizontal bar and universal joint. Although the holes could not be started at a height greater than 6 or 8 feet, it was possible, by giving some of them an upward inclination, to break the overlying material into a size suitable for loading. Lifter holes near the bottom of the bench were put in with Jackhamers, each mounted on a plank ramp devised for the purpose.

In driving the top heading, the con-

MISCELLANEOUS VIEWS

Top– Compressor house, lower portal of diversion tunnel, and South Fork of Flathead River. Hungry Horse Dam will rise where the stream bends and is lost to view. Center– The town of Hungry Horse, Mont., built to house the U.S. Bureau of Reclamation personnel that will be engaged on the dam project. Insert– Head men for Guy F. Atkinson on the tunneling contract. Left to right: Ralph Hawkins, general superintendent; Carl Nelson, tunnel superintendent; Oscar Peterson, walking boss. Bottom– Bureau of Reclamation office.

THE TWO PORTALS

All tunnel driving was done from the lower portal (left). Above is shown a power shovel excavating rock to establish a vertical face at the upper portal.

tractor used the newly developed Ingersoll-Rand Carset Jackbits attached by stud-type screw connectors to hollow alloy-steel rods of 1-inch hexagon section. The latter were of nine different lengths, varying from 2 to 18 feet and providing for changes every 2 feet. All other drilling was done with standard steel Jackbits. The wagon drills were fitted with 1¼-inch, hollow, round rods in 6-, 12-, and 24-foot lengths.

Blasting was done with 40 and 60 percent gelatin dynamite, using electric caps ranging from No. 1 to No. 12 delays, and with 220-volt current. The average advance per round was 14 feet. Because gauge wear of Carset bits is negligible, bits following one another in the top-heading holes were of the same size, 1½ inches. Hole diameters were consequently uniform throughout and smaller than they would have been if steel bits had been utilized, thus permitting the use of powder cartridges of smaller section. Less explosive was consequently needed. Although the nature of the job precluded keeping accurate records, a representative of the contractor stated: "We are definitely sure that a substantial reduction was made in the quantity of powder required."

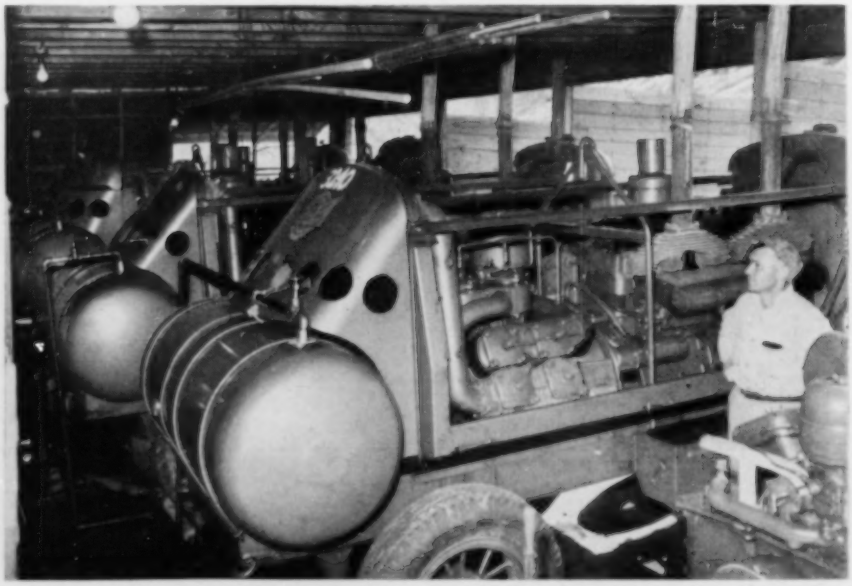
Broken material was loaded into 20-cubic-yard Sterling diesel trucks by a 1½-yard electric shovel. Operations were conducted on a 2-shift basis, with one crew assigned to drilling, loading, and shooting the holes and the other concerned primarily with muck removal. Compressed air for the drills was supplied by five Ingersoll-Rand 500-cfm. Mobil-Air compressors. The tunnel was ventilated by two fans blowing 16,000 cfm. of fresh air through a 16-inch metal pipe line to the working zone. Frequent tests were made of the air at the heading. When noxious gases were found to be present, as occasionally happened after blasting and during mucking, operations were suspended until sufficient fresh air could be introduced to overcome this condition.

Very little water was encountered in the tunnel, and all drilling was done wet in order to allay dust. Water for this purpose was pumped from the river to a tank placed high enough on a hillside to provide gravity flow to the heading at a pressure of 75 pounds. After being chlorinated, water from the same supply system was used for drinking and bathing.

Although the rock was highly fractured, it stood well in the walls and roof, and no timber or steel supports were required in the tunnel, which will not be lined for its river-diversion service. However, since the work was carried out in winter, with temperatures dropping to 25° below zero, the surface had a tendency to loosen by alternately freezing and thawing. This necessitated frequent and careful scaling. Also because of the cold, water and compressed air for the drills had to be preheated. No power lines had reached the dam site at the time tunneling was underway, so electricity for lighting, blasting, and operating the shovel was supplied by three diesel engine-driven generators.

Safety regulations of the Bureau of Reclamation were rigidly observed throughout the course of the work, and exceptionally few accidents occurred for a job of this nature. All persons entering the tunnel were required to wear protective headgear; and only diesel engines, properly adjusted, were permitted underground for haulage and other purposes. All workers were provided with safety boots and goggles, and every possible precaution was taken to safeguard their health and to eliminate hazards generally.

The Guy F. Atkinson Company organization on the job was headed by R. L. Hawkins, project manager, with Charles Ewing as his assistant. Carl Nelson was tunnel superintendent.



PART OF COMPRESSED-AIR PLANT

Three of the five Mobil-Air compressors that furnished air for tunneling. Note the piping leading to the fuel tanks at the left ends of the machines for replenishing the fuel supply.

AERIAL VIEW OF STORAGE FIELD

Pipes in the foreground are laid out ready for placing in the trench system. Excavating machinery is at work in the far section of the plot. The compressor and distribution plant is at the lower right. The 160-acre tract will permit an ultimate storage of 70 million cubic feet of gas. Its present capacity is 40 million cubic feet.

Natural Gas Stored in Underground Pipes

NATURAL gas tapped from fields of the Texas Panhandle and piped nearly 1000 miles by the Public Service Company of Northern Illinois is being stored by the latter in a novel arrangement of buried pipe sections. This method of storage is the first of its kind in the country and originated when the company, faced with the necessity of enlarging existing facilities to meet increased consumer demand, decided to explore the possibility of storing gas underground instead of on the surface in conventional holders. Accordingly, in the fall of 1946, a pilot installation was made at Kankakee, Ill., with a capacity of 1,250,000 cubic feet. The success of this project led to the completion, recently, of a similar system on a 160-acre tract at Mount Prospect, Ill., where 40 million cubic feet of gas is stored underground.

The postwar growth of the Chicago district made it imperative that the Public Service Company enlarge its storage facilities in that area. At Kankakee, some 25 miles south of Chicago, the utility serves 9200 customers. An influx of new industries, increasing population, and the greater use of gas by its regular consumers had threatened to outstrip the reserve storage capacity maintained there. North and northwest of Chicago the company has 50,000 customers of whom some 25 percent burn gas for heating homes, offices, or other buildings. This resulted in an extremely high peak load on cold days, making it difficult to meet all needs and still maintain a reserve supply. To solve the problems of both the Kankakee and Mount Prospect areas, the Public Service Company decided to try underground storage.

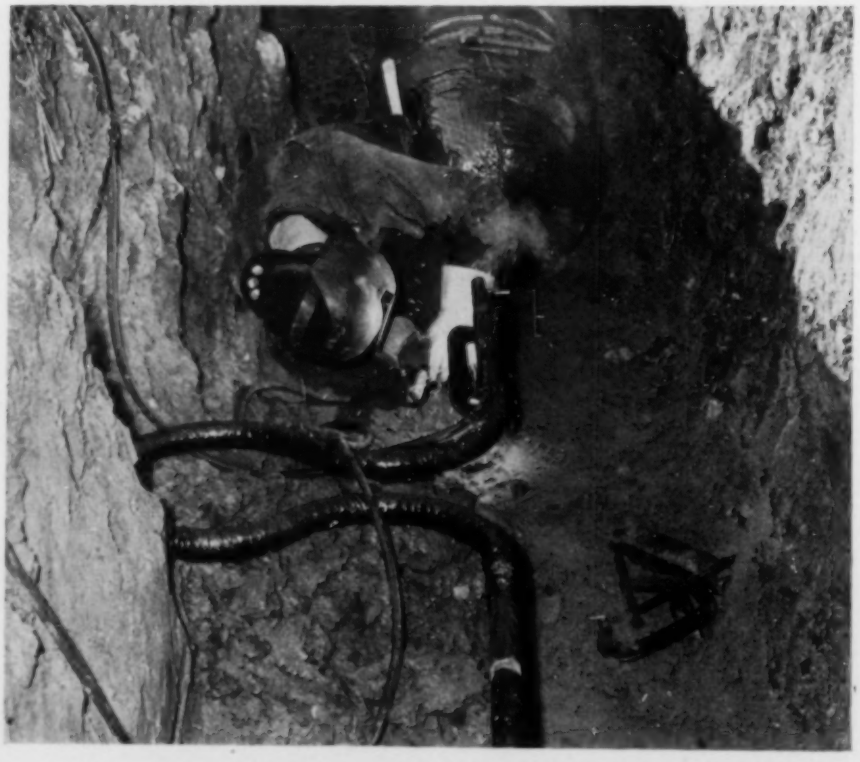
Because there was no installation to serve them as a guide, the company engineers had to start from scratch in designing the system. The kind and size and length of pipe to be used had to be determined, and exhaustive tests had to be conducted to insure pipe that would withstand the high pressures involved. The pattern in which the pipe should be laid in the field had to be worked out, and the depth at which it should be buried decided upon. A means of increasing or decreasing the pressure of the gas entering storage or going back into the distribution system had to be developed.

Seamless pipe of high-carbon, molybdenum-alloy steel, similar to that used in the construction of the "Big-Inch," was eventually selected. It has an outside diameter of 24 inches and a wall thickness of approximately ½ inch and was made by the National Tube Company of Pittsburgh, Pa. Random lengths were utilized, the average being about 40 feet. Because the high-carbon steel would have been difficult to weld in the field, both ends of each pipe section were forged at the fabricating plant into hem-

ispherical shape and the solid hubs were drilled and tapped to receive 1½-inch threaded connections. After being stress-relieved, the unit was tested hydrostatically at 2800 psi. before being shipped. The volume of each container averages 1C9.5 cubic feet, the weight 5100 pounds, and the capacity 25,000 cubic feet of natural gas at 2240 psi. pressure.

At the site, the pipes were laid out in advance of installation in groups of 40; that is, in operating units having a capacity of one million cubic feet each. They were spaced 8 feet end to end in rows 15 feet apart and with eight containers to the row, this spacing being chosen to facilitate installation and to make sure that the failure of one section would not disturb neighboring sections. The total land area occupied by each 1,000,000-cubic-foot unit is 57,510 square feet, or 1.32 acres. This pattern will ultimately permit the storage of 70 million cubic feet of gas on the 160-acre Mount Prospect tract and leave generous clearances for property lines, the operating station, and a creek which runs through the tract.

Trenches were dug approximately 3 feet wide and 6 feet deep by a crane equipped with a scraper. On the bottom of each was placed a layer of sand to serve as bedding. Before the pipes were laid they were thoroughly cleaned with



PLACING PIPE IN TRENCH

After being coated with pitch and wrapped with asbestos felt to minimize corrosion, each pipe was lowered into a trench bedded with sand. Sections were accurately spaced to accommodate previously made connectors. One of the latter, with a loop to take care of expansion and contraction, is shown in the lower view being welded into an adapter at the necked-down pipe end.

air-driven wire brushes, coated with heated coal-tar pitch, and wrapped with asbestos felt as a protection against corrosion. So enveloped, each was tested with a Holiday detector—an electronic device that indicates any weak spots in the coating. To further minimize the effects of corrosion, magnesium anodes were provided to give cathodic protection. All this work on each section was done at the point where it was to be installed, the pipe being placed on rollers for ease of handling and rotated by an arrangement of gears driven by a gasoline engine.

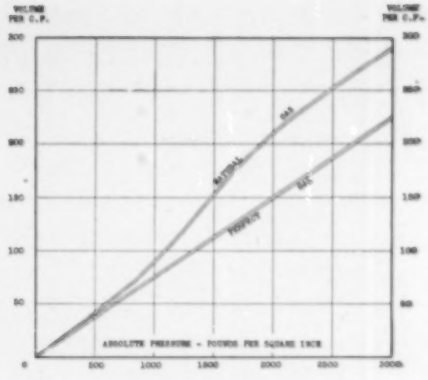
When a section was ready, it was lowered into the trench by the crane and accurately spaced with the aid of a special gauge so that the pipe connections could be made up elsewhere and installed without the need of cutting or bending and without again moving the container itself. Lengths of 1-inch steel pipe, coated for protection against corrosion and bent in the shape of a loop, were used to join the sections and were fitted into the 1½-inch openings in the pipe ends by a special adapter threaded at one end and bored at the other. Two men working with a 60-inch wrench screwed in the adapters, to which the connecting pipe was then welded. The loop in the latter allows the pipe sections to expand and contract with temperature variations or changes in the pressure of the contained gas.

As each 1,000,000-cubic-foot unit was completed, it was tested by introducing gas at a pressure of 2350 psi., the gas cooling to ground temperature within a few hours and dropping in pressure to about 2240 psi. All joints, both welded and threaded, were next tested for leaks by covering them with water. After passing inspection, they were embedded in sand and the trench backfilled.

The 40 pipes in each unit are connected to a 2-inch manifold that is used to fill or empty them, while a 4-inch header serves the 2-inch manifolds of six units and, in turn, is connected through valves to two 8-inch manifolds that lead to the compressor house and the sendout station. An indicating pressure gauge is provided for each operating unit, and a recording thermometer is installed for measuring the storage temperature of each six million cubic feet of gas.

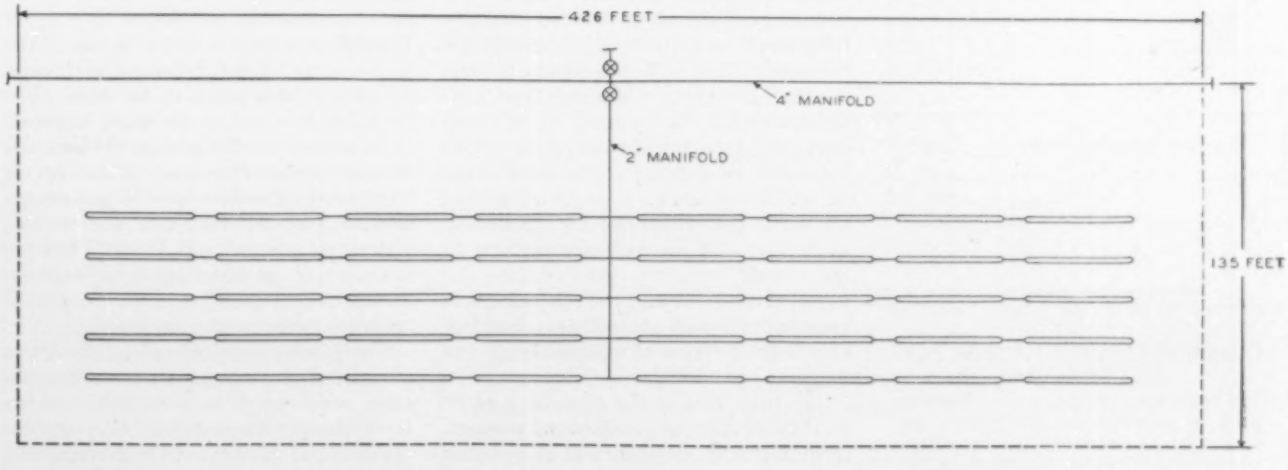
Of particular interest in this type of storage is the effect of high pressure on the compressibility factor of natural gas. At the operating pressure of 2240 psi., natural gas deviates most from its expected performance, as calculated according to the laws for a perfect gas. Wheras computations indicate that 160 cubic feet of perfect gas can, under a pressure of 2240 psi., be compressed into one cubic foot of space, it is actually possible with the same pressure to force 230 cubic feet of natural gas into the same space. This behavior of natural gas increases the capacity of the pipe sections by some 40 percent, permitting the storage of much more gas than their actual volume would seem to indicate.

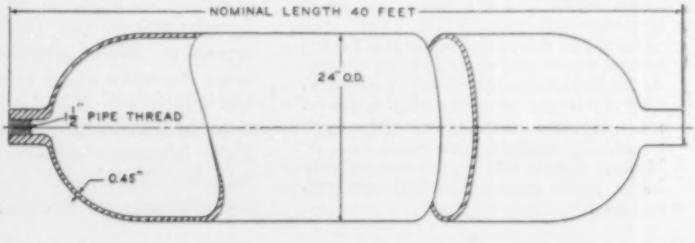
As the compressibility factor of natural gas becomes increasingly favorable with decreasing temperature, it is desirable to bury the pipe at a depth that will give reasonably low temperatures in winter and yet minimize seasonal changes. At 2240 psi. pressure, each 1°F. variation in temperature causes a pressure change of about 10 psi., one half of which is attributable to the change in the compressibility factor that accompanies the temperature change. Owing to seasonal temperature variations, some gas must be withdrawn from storage in spring and summer and a corresponding amount put back in fall and winter.



EFFECT OF SUPER COMPRESSIBILITY

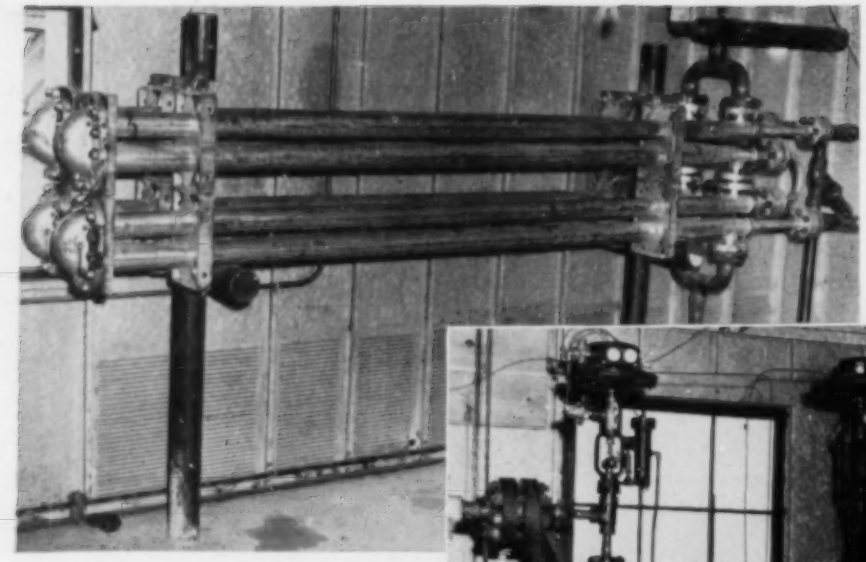
According to Boyle's law, the volume of a gas at constant temperature varies inversely with the pressure. However, natural gas deviates from this law to the extent shown in the graph. At 2240 psi. pressure and 40°F. temperature, approximately 43 percent more natural gas can be compressed into a given volume than in the case of a perfect gas. Actually, 230 cubic feet of natural gas can be stored in one cubic foot of space under the conditions stated. In testing this phenomenon, which is called super-compressibility, it was found that ten pipe lengths in this storage system were capable of holding 187,000 cubic feet of air when charged under 2300 psi. pressure. They were then emptied and filled with 260,000 cubic feet of natural gas under 2240 psi. pressure.





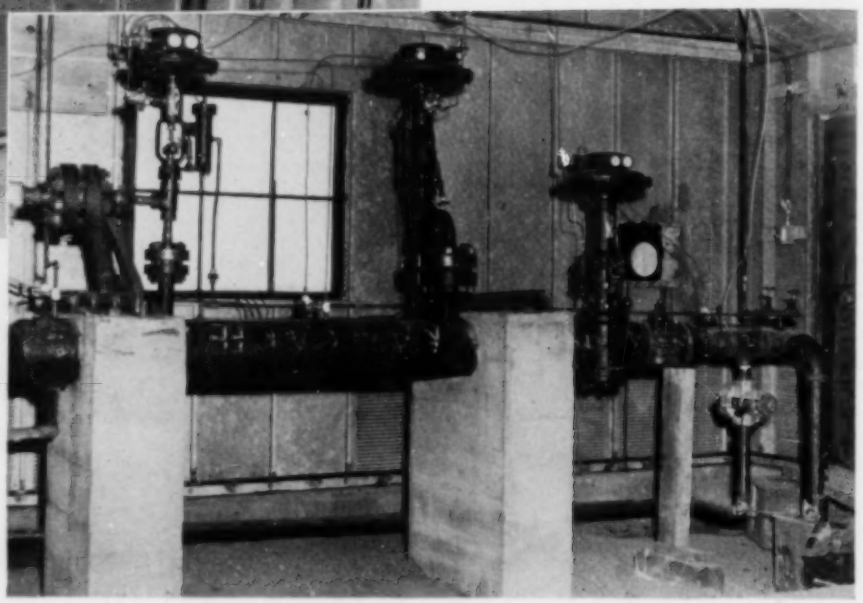
ARRANGEMENT OF PIPE SECTIONS

The upper drawing shows the general layout of a 40-pipe storage unit for one million cubic feet of gas. The sections, details of one of which are at the right, are spaced 8 feet end to end, with 15 feet between rows. The molybdenum-bearing steel of which they are made has a tensile strength of 100,000 pounds per square inch. The gas content, at 2240 psi. pressure, weighs approximately 20 percent as much as the pipe.

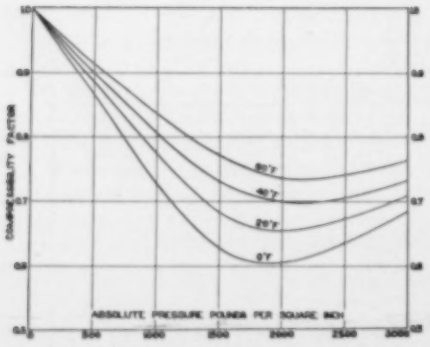


HEAT EXCHANGER AND PRESSURE REGULATOR

Gas withdrawn from storage for distribution is reduced in one stage to the send-out pressure of 50-100 psi. Apparatus that was used for this purpose in the pilot plant is shown below. To counteract the refrigerative effect of the pressure reduction and to prevent the gas from freezing in the valves, it is first heated in tubular-type heat exchangers (left).



Two high-pressure compressors, having a combined capacity of approximately 1½ million cubic feet per day, are used to fill the storage field with gas. These are Ingersoll-Rand 4-stage units driven by direct-connected motors of 400 hp. each. The equipment for withdrawing gas from the field was designed for a maximum hourly capacity of about 1¾ million cubic feet. Regulation is in one step in which the pressure of 2240 psi. is reduced to 50-100 psi., the distribution pressure. If this were permitted to take place without the application of heat, the final temperature would drop to a point as low as minus 80°F., which might cause regulators to freeze and excessive contraction of the distribution mains. Before its pressure is reduced, the gas therefore goes through heat exchangers using low-pressure steam.



COMPRESSIBILITY FACTOR FOR NATURAL GAS

The compressibility factor is a multiplier used in determining the volume occupied by a given weight of "deviating" gas from the volume occupied by the same weight of a gas that conforms to the ideal-gas compression laws. For natural gas, this factor varies at different temperatures and pressures, as shown. At the design storage conditions of 40°F. and 2240 psi. pressure that apply to the underground installation, the compressibility factor is less than .70. At higher pressures, the compressibility factor again approaches that of a perfect gas.

Underground storage of gas has many advantages over surface storage. Because the containers are buried they cannot be harmed by storms and are influenced but little by atmospheric changes. They offer no hazard to nor are they in danger of damage from low-flying aircraft. Being made up of many units, the capacity of the system can be increased, as desired, by the installation of additional units. One or more can be taken out of service for inspection or repair with no noticeable effect on the over-all capacity. Furthermore, the initial investment and the operating and maintenance cost are usually considerably below those of conventional gas holders.

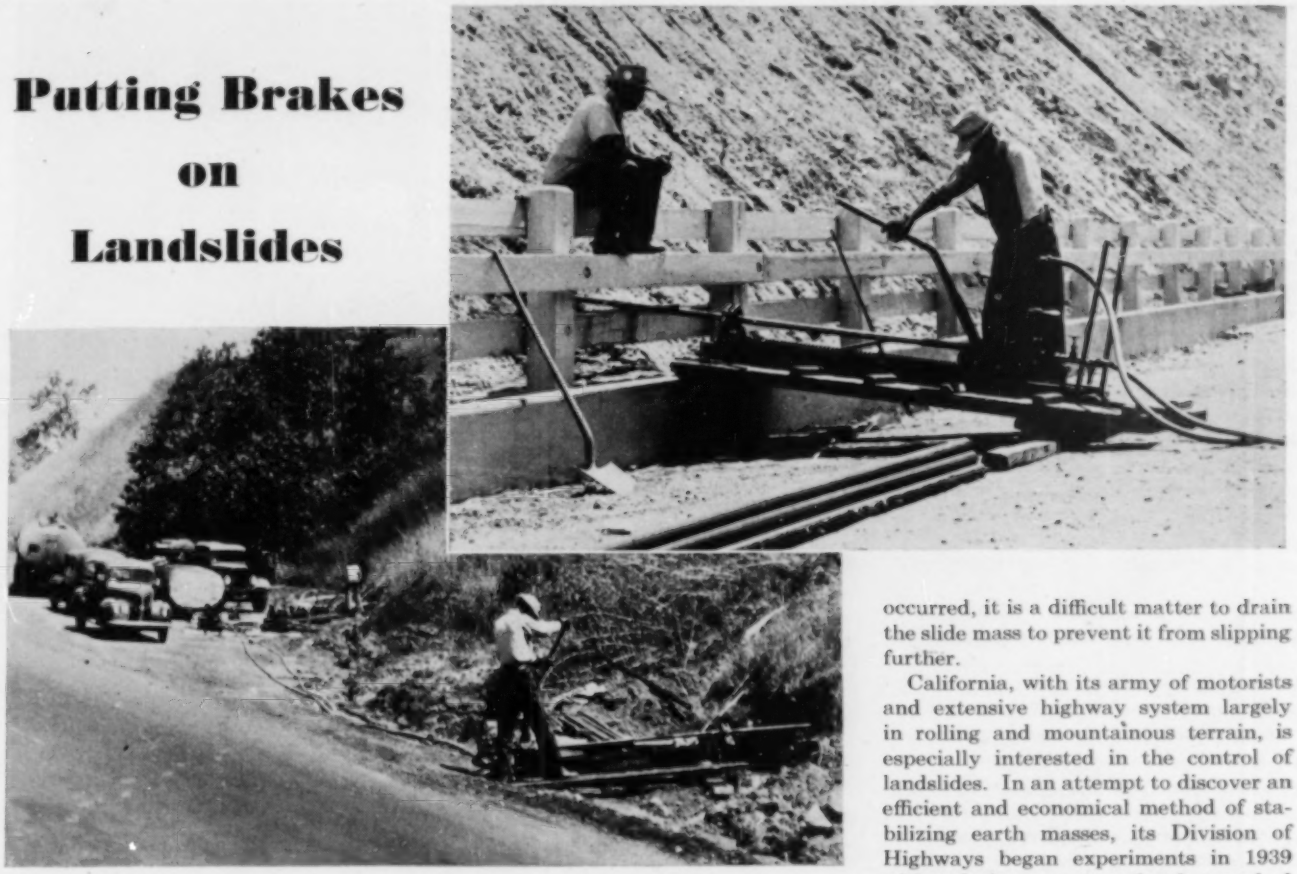
The total cost of the 40 million cubic feet of storage space at Mount Prospect, including land, engineering, compressor and sendout station, etc., was approximately $60-65 per 1000 cubic feet of capacity. When developed to its ultimate capacity of 70 million cubic feet, the figure per 1000 cubic feet will, it is computed, be in the neighborhood of $55. Although no data on recent surface installations in the Chicago area are available, it is estimated that conventional, low-pressure gas holders of equal volume would involve an expenditure from three to five times as great. A 10-million-cubic-foot holder is about 200 feet in diameter, 300 feet high, and contains a piston that rises or falls as gas is delivered or withdrawn. Four such units would be needed to provide the storage capacity of the Mount Prospect system. Even the painting of such structures, which has to be done periodically, is a major item of expense.

In addition to the storage system, the Public Service Company maintains in the Mount Prospect area a gas-manufacturing plant with five carbureted-water-gas sets, as well as facilities for the storage and distribution of propane. These, combined, have sufficient capacity for a 2-day maximum load.

The Mount Prospect storage field was completed and in operation six months after work on it was started. Stone & Webster Engineering Corporation planned and supervised the project, and the Contracting & Material Company of Evanston, Ill., installed the pipe sections.

The information in the foregoing article was obtained mainly from a paper, entitled *Storage of Natural Gas in Underground Pipe Sections*, presented before the Gas Fuels and Combustion Section of the Western Society of Engineers, Chicago, January 26, 1948, by D. V. Meiller, staff engineer of the Public Service Company of Northern Illinois.

Putting Brakes on Landslides



DRILLING OUTFITS AT WORK

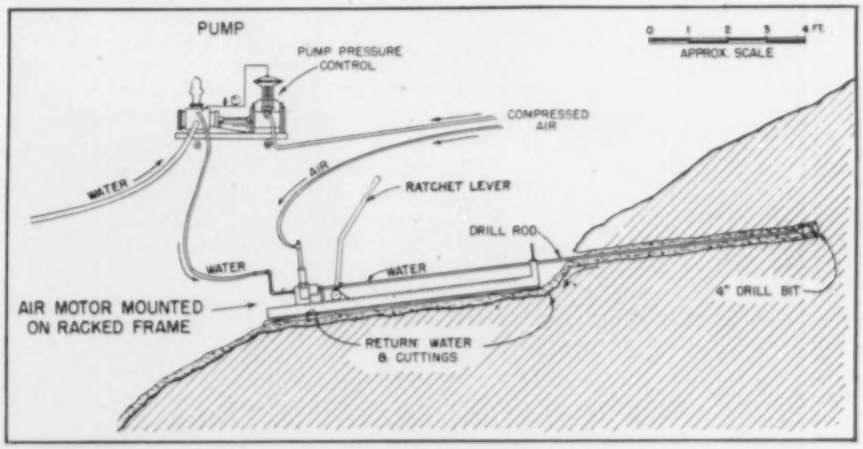
Hydraugers putting in holes at the bases of two slopes in California. Portable equipment supplying compressed air and water are shown in the background of the lower view.

MOTORISTS driving through mountainous regions often encounter signs warning them that there is danger of landslides ahead, but few are aware of the amount of time and effort spent by state highway departments in attempting to prevent rock and earth from avalanching. Aside from the menace they represent to vehicular traffic, slides often do extensive damage, and the removal of the obstructions from the lanes is a costly and time-consuming procedure. For these reasons, most states find it necessary to carry on active programs of slide prevention and control. The work involves the stabilization of both rock slopes and earth embankments, and it is with the latter that we are concerned.

The main cause of landslides is subterranean water which may induce sufficient hydrostatic pressure to increase the already existing driving force of the earth to a point where it will slip. Again, formations not infrequently contain dipping strata of clay or other plastic material which, if lubricated by ground water, may cause slippage of the overlying mass. Various methods are used to stabilize cut slopes and hillsides that give evidence of impending movement. They may be benched, reduced in slope, or relieved of excess material. Sometimes drainage trenches are dug, vertical sand drains are provided, or blankets of pervious material are spread over inclined surfaces. However, where a slipout of a built-up embankment or cut slope has occurred, it is a difficult matter to drain the slide mass to prevent it from slipping further.

California, with its army of motorists and extensive highway system largely in rolling and mountainous terrain, is especially interested in the control of landslides. In an attempt to discover an efficient and economical method of stabilizing earth masses, its Division of Highways began experiments in 1939 with a drainage system that has worked so well that it is now standard practice in the state. It involves driving horizontal holes into the ground for perforated metal pipes to collect and carry off the subterranean water which, as we have already said, is the chief cause of slides.

Equipment manufactured by the Hydrauger Corporation, Ltd., is used to drill the holes. The machine, whose construction and operation have been described in our March, 1931, and May,



TYPICAL DRILLING SET-UP

A reversible air motor furnishes the power for turning the boring bar, and a ratchet-type jack pushes the casing into the hole. On the average job each Hydrauger is served by a 120-cfm. portable air compressor and consumes around 4000 gallons of water in eight hours. The function of the water is to wash away cuttings and to cool the bit.

1941, issues, was designed primarily to enable public-utility companies to install pipes and conduits beneath busy thoroughfares without interrupting traffic. It consists essentially of a reversible air motor mounted on a racked frame and of a ratchet lever that moves forward and backward on the track. Compressed air and water are supplied by rubber-hose connections, the former powering the motor and the latter being pumped through a hollow drill rod to remove the cuttings from the hole.

Experience gained by the Division of Highways in slide prevention by the Hydrauger method has led to the following uniform procedure. All drilling is done by a traveling crew assisted by men from local maintenance stations. Equipment and supplies needed for the work are carried by the crew, except the metal pipe or casing for the holes. This is stockpiled at different locations throughout the state. Where a slide or slipout is imminent or has occurred, a preliminary study is made of the area to estimate the number and length of the drains required to stabilize the earth mass and to determine where the pipes are to be placed.

Upon the arrival of the drilling crew, its first tasks are to clear spaces in which to set up the Hydraugers and to secure an adequate supply of water for the operations. Tanks are used to transport water where local sources such as springs or streams are unavailable. Portable compressors are then stationed at convenient intervals between the drilling units, and air and water pipe lines, with take-offs at each machine, are run the length of the working zone. After the track of each Hydrauger has been set up and adjusted for the correct slope and alignment of hole, the drill assembly is placed on it, hose connections are made, and boring can begin.

Drilling is generally done with 4-inch auger-type bits attached to size "A" hollow diamond-drill rods which come in 5-foot lengths. Sections are added successively with increasing penetration, and when a hole has reached the proper depth the rod is backed out by reversing the air motor. The latter is then removed from the track and in its place is installed a ratchet-type jack to drive the casing into the hole. The pipe is 2 inches in diameter and approximately 21 feet long, and as the sections are jacked in they are butt-welded to form a continuous drain.

Perforated on three-quarter points, the casing is usually installed with the openings facing upward so that water cannot leak out when passing over cracks and fissures. However, in sandy soil the perforations are below so as to prevent the sand from entering and blocking the drain. After all the pipes are in position, they are tied together by a larger, common drain leading to culverts or other points of disposal beyond the slide area.

Although the holes were originally drilled with a 2½-inch bit followed by a 4-inch reamer, it was found that the 4-inch auger bit alone gave more satisfactory results. In the meantime, the latter has been greatly improved by putting a carboloy insert in the lead point and by facing the cutting edges with a hard material. Dry, clayey shales and soft sandstone that checked the progress of the older-type bit are easily penetrated by the new one. In shale, sandstone, and partially decomposed granite is used a special bit with carboloy inserts in the cutting edges as well as in the lead point.

In the past, the presence of hard float rock and conglomerate considerably hampered the drilling operations, and to overcome the difficulty the Division of Highways has recently tried standard diamond bits and core barrels with the Hydrauger. The results proved satisfactory, but as the tools must be withdrawn each time a 10-foot core is taken, work is slowed down and costs increased. The diamond bit and accessory are therefore utilized only in drilling hard rock, holes usually being started with the auger bit and resumed with it when softer material is again encountered. A modified form of fishtail bit has occasionally been used in sandstone and shale strata; but, even though it cuts rapidly, it is not suitable for holes of any appreciable length because of difficulty of directional control.

FLOW FROM DRAIN PIPE

This horizontal pipe was driven into the Cloverdale Slide in California by the Hydrauger method and drained the unstable ground at the rate of 6000 gallons of water per hour.

Because much of the work is done in active slide areas, it was often something of a job to install the metal pipe after a hole had been drilled. To obviate this, a drill rod with a folding auger-type bit is now run through the 2-inch casing. By means of a double-track set-up, the pipe and rod are moved ahead together until the farther end of the hole is reached. The bit is then collapsed and withdrawn, leaving the casing in place.

While horizontal drains are sufficient in most formations, stratified areas containing flat-lying deposits of clay require supplemental treatment. Under those circumstances, vertical holes of large diameter are drilled and filled with sand. Horizontal drainage holes, such as have been described, intersect the vertical sand drains. The latter serve to release the water impounded between the impermeable layers of clay, and the horizontal pipes drain it from the earth mass.

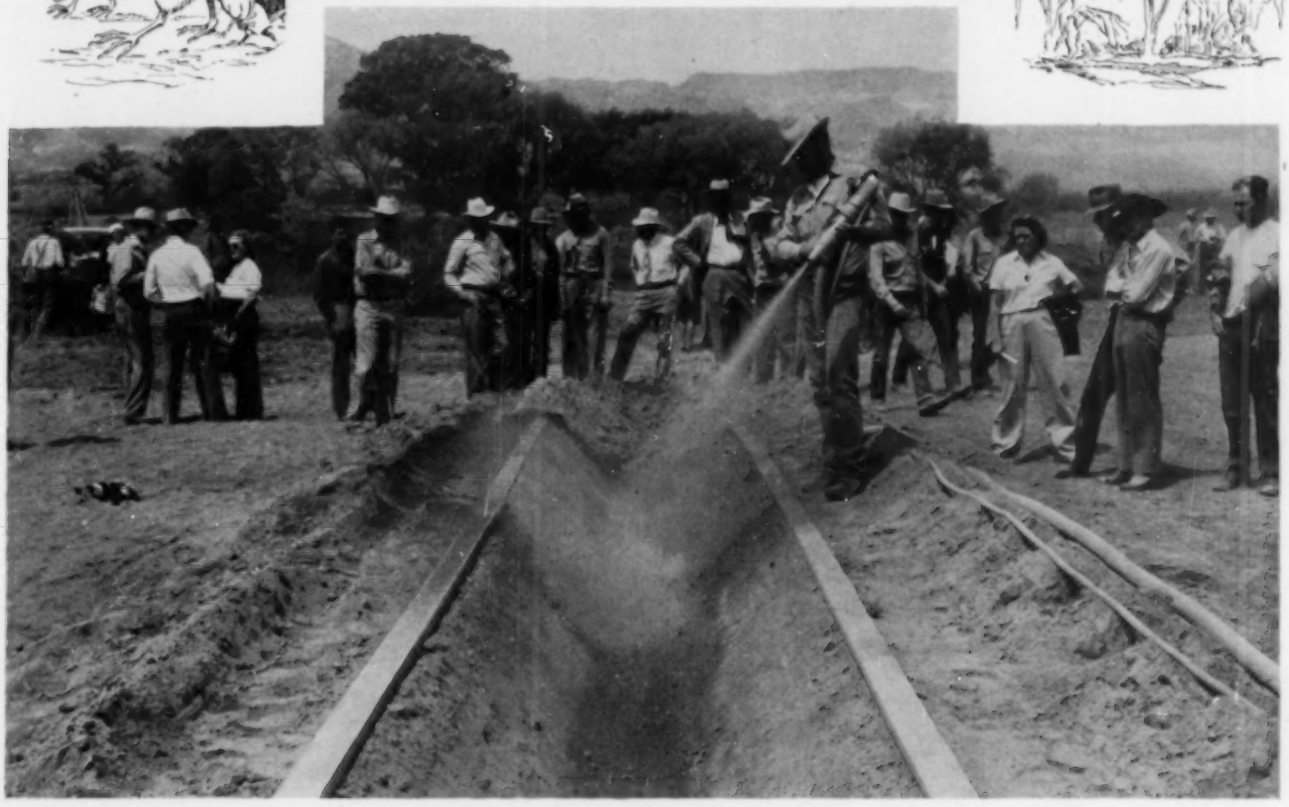
Proof that the California Division of Highways has found the drainage system effective in stabilizing cut slopes and embankments is offered by the 53 slides and slipouts which have been treated by the method since 1939. In this work the six state-owned Hydraugers have drilled approximately 1150 horizontal holes with a total length in excess of 130,000 feet.

STABILIZED SLIDE

A side-hill section in which movement has been arrested by inserting perforated horizontal drains. The slide occurred along the near vertical face where considerable subsidence is noticeable. In the course of the slippage, the area was entirely denuded of its heavy growth of trees.

COMPRESSED AIR HELPS THWART WEEDS AND GOPHERS

Bonnie and Ed Peplow



GUNITING AN IRRIGATION CANAL

Neighbors from miles around watched as a newly dug ditch was coated with a weed-and-gopher-resisting concrete mixture applied by air pressure. Equipment of the type shown has long been used for lining tunnels, etc.

WEEDS, gophers, and seepage are the three principal headaches of farmers in the maintenance of irrigation ditches. How these problems can be solved effectually and economically with compressed air was recently demonstrated dramatically upon the occasion of a dawn-to-dusk remodeling of a depleted, neglected 35-acre farm at Bridgeport in Arizona's Verde Valley. Owned by Bob Hardgrave, a partially disabled veteran, and his wife Zillah, who bought it last fall on a GI loan because they could afford nothing better, the farm was selected for a one-day demonstration of soil-conservation practices because it needed practically every conservation measure in the book.

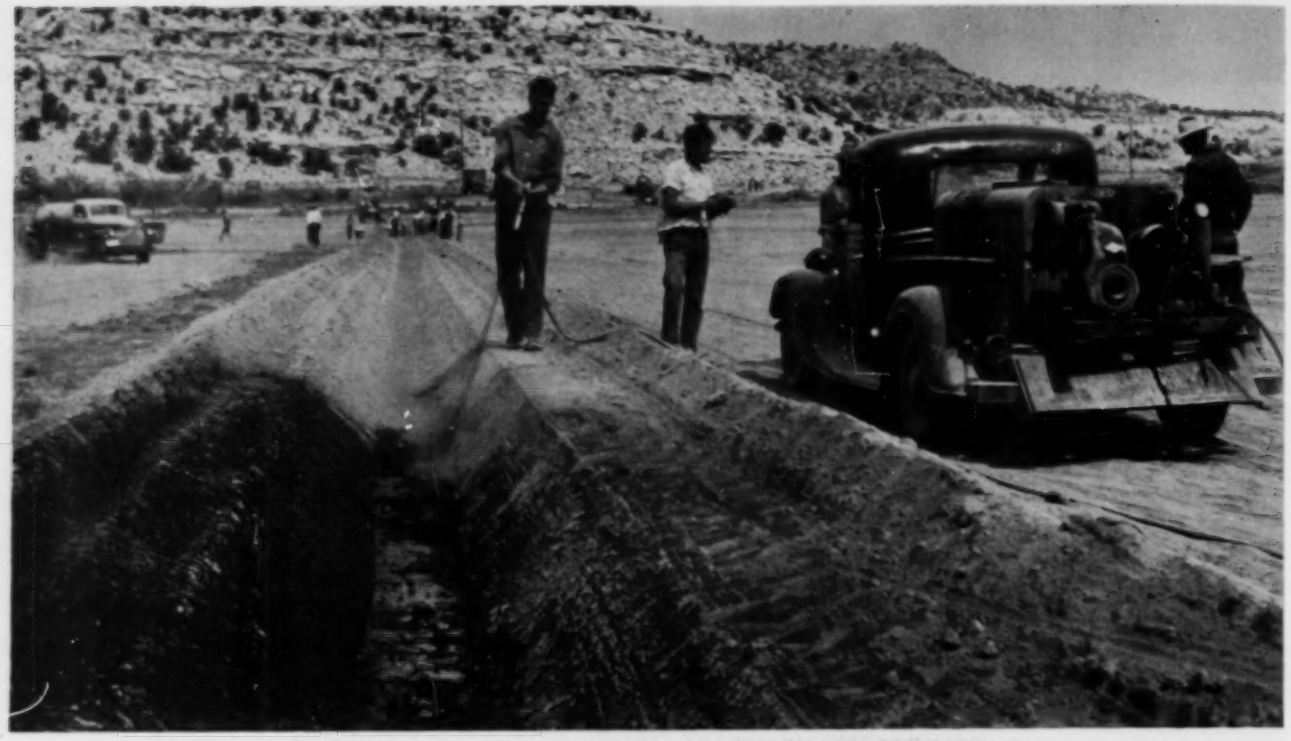
The event was sponsored by the U.S. Soil Conservation Service and three soil-conservation districts, and what would normally be accomplished in a decade was done in a day. Fields were terraced and leveled, a large storage reservoir was built, and a complete irrigation system was laid out and constructed. Machinery and supplies required to do the work were loaned or contributed by business concerns throughout the Southwest. Big crawler-type tractors and all sizes and kinds of equipment down to small garden tractors performed before more than 5000 farmers drawn from hundreds of miles around.

Some of the irrigation ditches that were dug were left unlined, as are a great many in the Southwest. Such canals are effective so long as the farmer applies himself energetically to forestall their becoming clogged with weeds, to prevent seepage, and to fight the sabotage of gophers, all mostly by hand labor. But even with the help of good terriers and a lot of snakes it's a pretty tough job to keep gophers from burrowing in and ruining ditch banks.

Other sections of the system were lined with ready-mixed concrete poured into forms. A coat 1½ inches thick provides an effective defense against weeds and seepage, and even gophers, but the initial cost puts a crimp in the budget of a farmer of moderate means. Two others were lined with concrete by a simpler method that has gained wide acceptance in irrigation circles. The material was applied under the force of compressed air by a machine of the Gunite type that is often seen in the more populous and prosperous areas of the Southwest.

Still another stretch, a 700-foot length of lateral canal, was sprayed with oil. Although oil has been used to coat the sloping walls of ditches for a long time, its application with hand brushes is so difficult and time-consuming that it virtually offsets the saving in cost of material, as compared with concrete. However, when oil is sprayed on, it is, as experience has proved, a cheap and effective weapon in the small farmer's fight against seepage, weeds, and gophers.

At the Hardgrave demonstration, the oil-spraying job was done by the Cotton-



SPRAYING OIL

Less enduring but cheaper than facing ditches with concrete is the protection afforded by heavy oil sprayed on as shown here. The equipment used in this work also serves southwestern farms for spraying cattle and orchards. It consists of a truck-mounted, gasoline engine-driven compressor, tanks, hoses, and spray nozzle.

PARSON-PAINTER

As a part of the one-day refurbishing of the Hardgrave farm, the house was given a coat of paint. A merchant contributed the material, and the Rev. Henry R. Buhler, pastor of the church attended by the young owners, volunteered to apply it. With the aid of an air-spray outfit he completed the job well before sundown.

wood Fuel & Feed Company. Although Boyd Tenney, owner, and R.A. Patterson, manager, were not the first to treat irrigating canals in this way, they pioneered the idea in north-central Arizona. Their first work of this kind in the Chino Valley was done about a year ago, and labor was so inexpensive and progress so fast that the rig was kept busy all season. Last spring the company introduced the method to the Verde Valley, and the outfit used by it on the Hardgrave farm has been operating in the region ever since. It is the same one with which it sprays orchards and cattle and consists of a compressor driven by a gasoline engine, of tanks, and of hoses mounted on an old half-ton pick-up truck.

In the case of the 700-foot lateral, Patterson applied 275 gallons of No. 4 fuel oil, which retails at approximately twelve cents a gallon. This amount was sufficient for two coats at a cost of $33, not including labor, which totaled four man-hours. To insure good penetration, the fluid was sprayed under a pressure of 250-300 psi. through a No. 3 disk nozzle. For a new, raw ditch a double coat is recommended, but one application is enough for trenches that have previously been oiled, and that coat takes less oil than does the second coat of an initial spraying.

For best results ditches should be sprayed once a year, although it is safe sometimes to allow longer intervals between treatments. Patterson's and Tenney's success in this side line to their fuel-and-feed business points the way to others in the Southwest who are engaged in the work of spraying orchards and cattle, for they can add to their incomes by using the equipment for oiling the irrigation ditches that are found on almost every farm in that part of our country.

Desk Telegraph

IT WON'T be long now, according to Western Union, before business concerns will be able to dispense with the familiar messenger boy who calls for and delivers telegrams, for it is now possible to send and receive wires seated at a desk in one's own office. The new apparatus is called Desk-Fax, and is the outcome of war experimentation.

The user may write or type his message on a sheet of specially prepared paper to impress the text in wax on another sheet of electrically conductive paper. This is placed on a small cylinder in the instrument and scanned by a stylus, thus transmitting the telegram to the central telegraph office.

The machine will also receive an incoming message on paper wrapped on the same cylinder. It can handle up to 75 words a minute dispatching or receiving, it is claimed, and has been in regular use by twenty Newark, N. J., firms for several months.

The Ticket Chopper Comes Back

AMONG the interesting economic adjustments of the times was the doubling of fares on New York City's rapid-transit system, effective July 1. On that day the nickel ride, which had prevailed ever since the first underground railway began operating in 1904 and much longer on the now vanishing elevated lines, passed into oblivion.

For New Yorkers and the hordes of suburbanites that converge upon the city each day, the fare increase was of major importance. Although it will cost the individual perhaps just an extra dime a day, its cumulative effect is impressive. In the course of a year, during which more than a billion fares are paid on the subway system alone, the added nickels will grown into the respectable total of 50 million dollars.

Long inadequate to pay expenses, the 5-cent fare was one of the last-remaining symbols of a bygone age and something of an anachronism. Its one-time counterparts, the nickel cigar and nickel glass of beer, succumbed to rising price trends years ago. The fare increase dethroned the nickel as the most-used coin in New York and elevated the dime to that position. Preparing for the change, the Board of Transportation obtained ten million dimes from the Philadelphia mint to meet the first-day demand. A like amount was earmarked for immediate shipment on call. Ten million pennies also were stocked to insure ample change on municipally owned surface bus and trolley lines, on which the fare was boosted from five to seven cents.

Extensive alterations in the subways' mechanical fare-collecting facilities occasioned by the rise were carried out overnight with time to spare. By 6:15 a.m., 3391 turnstiles in 523 stations had been converted from nickel to dime operation at a cost of $93,000. Some confusion resulted when turnstile slots, too finely adjusted, refused to take dimes that were worn, bent, or otherwise off pattern. All these troubles were ironed out during the first few days following the change. By that time, too, patrons had overcome the habit of thrusting nickels into the mechanisms.

The inauguration of the new rate schedule brought back some of the old ticket-canceling machines—familiarly known as ticket choppers—that served elevated and subway lines before coin-operated turnstiles were invented. In those days passengers bought tickets and dropped them in a glass-sided box surmounting the machine. After a few had accumulated, the guard stationed at each chopper worked a projecting handle to chew up the bits of pasteboard and thus prevent their reuse.

The machines were widely employed for several decades, beginning in the 1880's. Besides serving New York's elevated and subway lines, they collected fares on ferryboats and bridges in New York and Boston and on various railroads elsewhere in the country. They were manufactured by the Ingersoll Rock Drill Company and successor concerns. They are now being used in subway and elevated stations where connections are made with surface trolleys and buses owned by the city. The revised fare on these conveyances is seven cents, with an additional five cents required for a transfer to the rapid-transit lines.

Officials of the Board of Transportation state that the boxes will remain in service. Some consideration was given to equipping them for power mastication, but this was not done, and attendants will pump the levers to cut up the tickets as in years gone.

BACK ON DUTY

A passenger entering the Fordham Road Station of the Independent Subway is shown above depositing a transfer received from a surface line in one of the old ticket choppers that have been restored to service. The guard has a hand on the handle that operates the chopping mechanism inside the box. At the right is a reproduction of a woodcut from an 1892 catalogue of Ingersoll-Sergeant Drill Company, which made many of the machines in the past century.

U. S. FOREST SERVICE PHOTOS

"COWS OF THE COUNTRY"

This was the name given to buffaloes by the first Spanish explorer to see the shaggy beasts. They are in reality bison, but we Americans erroneously call them buffaloes. Once numbered in the millions, they would have been exterminated save for a $15,000 congressional appropriation in 1902. Now there are several hundred of them, mainly in the national parks. These pictures show members of a small herd on the Kaibab Plateau in northern Arizona. In the group by the waterhole are two ranch cattle, evidence that the two species dwell together peaceably. Bison differ from typical oxen in their greater breadth, their larger limbs, the convexity of their foreheads, the hump on their shoulders, and in having fourteen pairs of ribs instead of thirteen. There are two varieties of American bison, the prairie and the woodland. Both feed on grass and on the leaves, small limbs, and bark of trees.

When the Buffaloes Roamed

Amy P. Burt

"BUFFALO fever" was an ailment common to western plainsmen nearly a century ago when great herds of American buffaloes roamed our vast prairies. The fever had to do with the fabulous prices—one to three dollars apiece—the hides brought! There were no scruples apparently about killing the magnificent beasts, and everywhere one went one heard others discussing the "big killing," as it was called. And big killing it was, indeed.

The wholesale slaughter reached its peak in 1878 and continued until the animal became almost extinct. Cattlemen grumbled that buffaloes were eating the grass upon which their cattle subsisted. Others declared that the wild Indian would never be brought under control until the beast that furnished him with food, shelter, and clothing ceased to exist. Had not Congress appropriated $15,000 in 1902 for the purpose of establishing a herd of captive buffaloes within a fence in Yellowstone National Park, we probably would not have a single living animal to exhibit today. This step in the preservation of the buffalo has resulted in numerous herds that now roam the plains of the great Southwest.

Probably the first white man who ever saw and described the buffalo was Cabeza de Vaca, the famous Spanish explorer who, with his companions, crossed North America from Texas to the Pacific slope in the years 1534-36. Cabeza called the great, humped, shaggy beasts *vacas de tierra* (cows of the country). They were still called cows as late as the eighteenth century, though the Spaniards that succeeded Cabeza referred to them as *cibola*, probably the Spanish form of *shiwiba*, a Zuni Indian word.

The Spaniards found that the humped cows provided the Indians of the prairies with many of their necessities. The animal was not only the bronzed nomad's chief source of food but it gave him clothing, bedding, pony trappings, and the walls for his tepees. It furnished sinews for bow strings and for sewing leggings, moccasins, and clothing, and also supplied rope and bags for meat. The hides were used for barter among themselves and in trade with their white brothers.

Buffalo meat was considered a great delicacy by Indians and plainsmen alike, particularly the hump and tongue. Much like beef in flavor, the meat is of coarser texture but juicier, and the lean and fat are more evenly distributed. Had the buffalo been hunted only for food, the natural increase would probably have compensated for loss. But the continuous and wanton killing of the

beasts by white hunters and travelers for sport or for the money their hides brought soon reduced their numbers. The demand for buffalo robes or rugs became so great that thousands and thousands of the animals were slaughtered.

Hunting started in the fall of the year. Frontier towns seethed with excitement as hundreds and hundreds of men poured in to buy outfits for the winter's work. Wagon trains loaded with huge stocks of ammunition, provisions, and camping equipment rolled into the communities, and as supplies were exhausted orders were rushed eastward for more. Equipment consisted of several "big fifties"—the name applied by buffalo hunters to the Sharps rifle—together with powder, lead, and primer. Also included were knives for skinning—the Wilson knife being the favorite for the purpose—and a sharpener. There was always a specially trained "skinner" in the outfit. His work required skill, for a hide might be ruined by bad slitting or cutting. An expert could skin from 50 to 60 hides a day, with never a loss. He ranked second only to an expert marksman. Everything was loaded on a wagon pulled by a yoke of plodding oxen, and the hunters and others in the party usually rode alongside on horseback.

For the most part, camp was established out on the plains, in the path of a herd on its migration north or south. The typical shelter was made tepee-fashion of buffalo hides, from eight to ten thick, and was large enough to house a number of men. A hole was left at the apex for the escape of smoke. Warm and tight and snug, the tent was sufficiently stout to stop a bullet, especially after the hides were dry. Snow and hail pelted the sides of the shelter and banked up beside it, and prairie winds whistled and tore around it, but those inside were as cozy as the proverbial bug in a rug.

Remote as they were from civilization, the hunters had no time to get bored or lonely. Their days were filled chasing down the great humped beasts, and even the hours after supper were busy ones. That was the time for whittling the wooden pegs which were used for holding down the hides, and for cleaning rifles and refilling cartridges. The latter task was not an easy one, for the empty shells had to be cleaned and reprimed. While one fellow cleaned them, another melted the lead which a third poured into the bullet molds. A fourth man was alloted the jobs of filling the empty cartridges with the right amount of powder and fitting in the slug.

The hides were removed from the carcasses on the spot, rolled into long bundles, and sent to camp by wagon. There they were unrolled and laid flat on the ground, to which they were pinned with 6-inch wooden pegs. For a week or two, depending upon wind and weather, they were exposed to the rays of the sun, a curing method the white man learned from the Indian. This drying process was called "pegging out." When the hides began to rattle just so when walked upon, "fleshing" began, and only an expert could tell when they were in condition for that work. The inside of each was gone over thoroughly with a scraper until it was as smooth and clean as parchment paper.

With fleshing completed, the hides were folded once lengthwise and stacked often 8 or 10 feet high. This was termed "ricking." As soon as a pile was ready, it was covered with a poorly furred or cured hide pegged to the ground with long strips of green hide and was allowed to remain at the site until the hunting season was over. Sometimes as many as eight or ten thousand pelts were carried back to town, shipped to market, and made into robes, coats, etc. It was not unusual for the five or six men constituting a hunting party to receive from ten to fifteen thousand dollars for their winter's work.

Many are the tales the old-timers tell of the vast buffalo herds that roamed the plains, disbanding wagon trains and even halting the progress of the puffing old iron monster. In May, 1871, Col. R. I. Dodge drove for 25 miles along the Arkansas River through an unbroken herd which, according to an estimate by W. T. Hornaday, famous naturalist, contained 3,500,000 head. It was the great southern herd on its annual spring migration to the north. Today the buffalo is numbered in the hundreds!

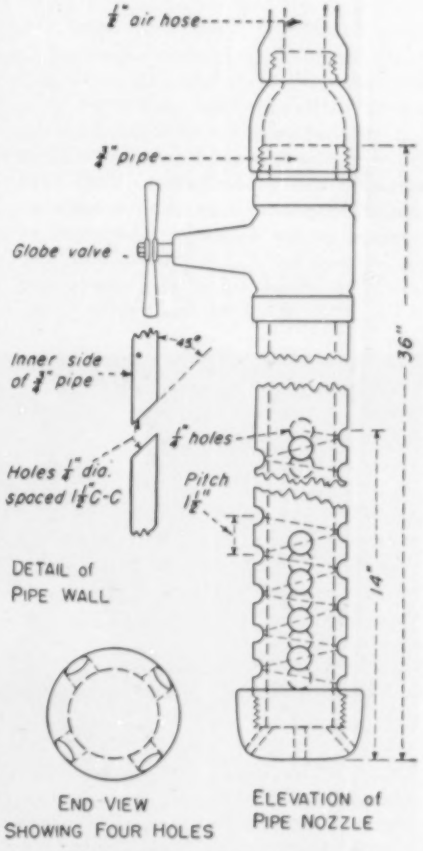
The American buffalo is really a bison, for the true buffalo, which is found only in Asia and Africa, has no hump. But so familiar is the name buffalo to us Americans that no attempt has been made to correct the mistake. We even have a buffalo nickel!

Pneumatic Device Compacts Concrete in Wall Forms

A SIMPLE pneumatic device for compacting concrete in wall forms was recently developed and used with success in the construction of a 6-story building in San Jose, Calif. According to the *Engineering News-Record*, it consists of a 3-foot length of ¾-inch pipe capped at one end and pierced with so many holes as to form virtually a sieve. Compressed air delivered to the pipe through a ½-inch hose bubbles up through the wet concrete and compacts it so thoroughly that no cavities or voids are left in the mass. It was the only method employed in pouring the walls and columns of the reinforced-concrete structure, and neither inner nor outer surfaces required finishing when the forms were removed.

The holes are ¼-inch in diameter and extend to a point 14 inches from the top of the cap. They are spaced on 1½-inch centers along a 1½-inch-pitch spiral and drilled at an angle of 45° to the axis of the pipe. With the capped end pointed downward, the inclination of the holes directs the jets of air upward, thus facilitating their passage surfaceward through the wet concrete. In confined areas such as wall forms, where there is usually considerable reinforcing, the agitator disperses and compacts the concrete without danger of disturbing the bond between steel and previous pours that have begun to set. Air at 30 psi. was found to be most effective, and the mix should have a slump of at least 5 inches.

Although designed primarily for use vertically, experiments proved that concrete underneath window frames or other obstructions in wall forms could be pushed horizontally by a modified form of the device. This consists of a length of ½-inch pipe with a right-angle bend approximately 7 inches from the capped end and having but one opening—a ⅜-inch hole—in the center of the cap. Working from both sides of a 7-foot-wide window frame in an 8-inch wall form, the tool, held vertically, compacted the wet concrete beneath the sill where the distance from the sill to the previous pour was not more than one foot.



DETAILS OF NOZZLE

Operating end of the pneumatic concrete compactor. It was devised by Robert Van Briggle of the Dinwiddie Construction Company, Pacific Coast contracting firm.

Air Siren Produces Ultrasonic Sound

SCIENTISTS at Pennsylvania State College are carrying on research in the field of ultrasonic sound; that is, sound too high-pitched for the human ear to detect. Using a lantern-shaped siren that converts compressed air into sound waves in the ultrasonic range, they are studying the effects of the sound on rats, mice, flies, mosquitoes, and other insect and animal pests. Results of the experiments indicate that, in addition to rodent and insect control, ultrasonic sound has other industrial applications.

The upper auditory limit of many animals is above that of man. Thus, dogs and cats will respond to the note of an ultrasonic whistle that is inaudible to humans. Rats and mice hear sounds in the ultrasonic range, and many insects such as crickets, katydids, grasshoppers, etc., produce ultrasonic sounds. The bat, for example, squeaks from 30 to 50 times per second while in flight and uses those ultrasonic sounds like radar. The sound waves, generated with a frequency of some 50,000 cycles per second, strike any object in the bat's path and rebound, the sensitive ears of the creature picking up the echoes and warning it of the obstruction ahead. Although these facts have been known for some time, studies of the practical application of ultrasonic sound have been undertaken only recently.

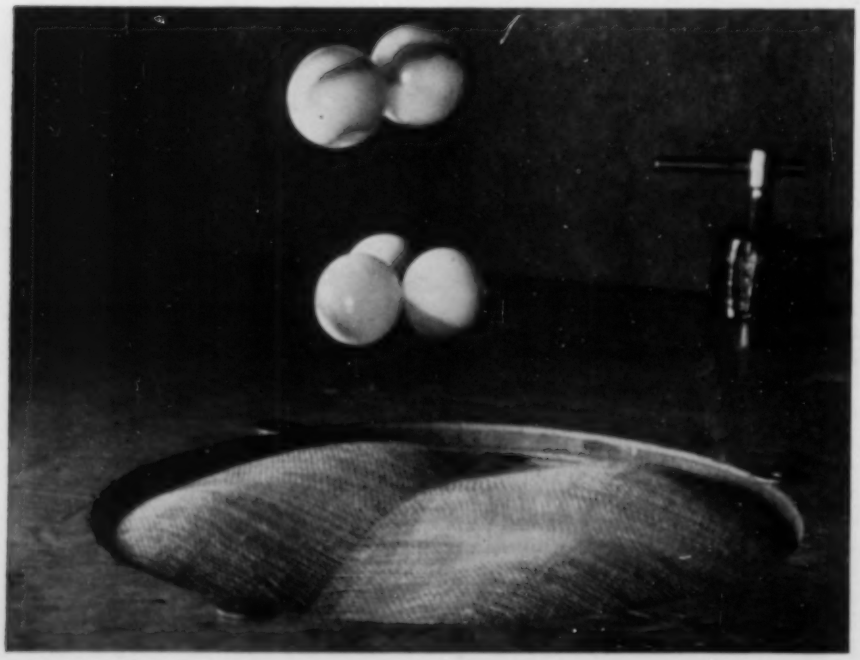
Work in this field was begun at Penn State during the recent war when the Army Signal Corps became interested in the possibility of signaling by ultrasonic sound. Although tests conducted with high-pitched whistles revealed that the sounds had too limited a range for that purpose, the investigations were continued along other lines. A siren was constructed in the acoustics laboratory of the college by C. H. Allen and Dr. Isadore Rudnick under the supervision of Dr. H. K. Schilling, its director. Compressed air admitted to the receiving chamber of the unit escapes through 100 small conically shaped holes spaced equidistant on a 6-inch circle. A wheel containing 100 teeth chops the emerging streams of air into pulses, each of which becomes a sound wave. When the wheel spins at 18,000 rpm., the sound generated has a pitch of 30,000 cycles, too high for the human ear to hear.

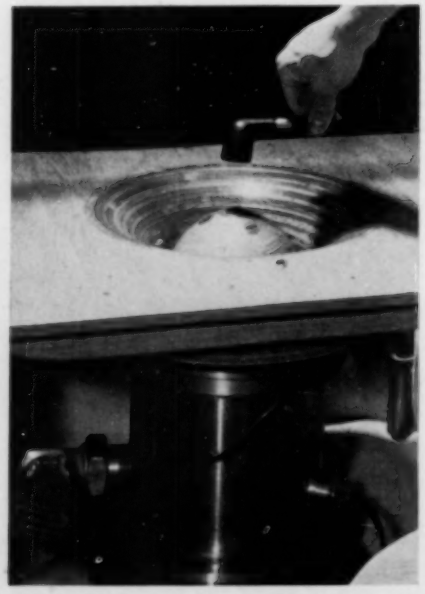
The highest level of intensity reached by the siren is 170 decibels, which is 10,000 times as intense as sound for which the sense of loudness disappears and pain sets in. In terms of acoustic energy, this is tremendous. The siren is capable of generating approximately 2000 watts as compared to ⅓ watt for a trumpet and 50 watts for a large orchestra. By contrast, the acoustic power of a person talking in an ordinary tone is extremely small. Assuming that all the acoustic energy thus generated were absorbed and retained by a half pint of water, it would take tens of thousands of years to boil it by talking to it. The siren does the job in a few minutes.

Researchers at the college, working under the direction of Dr. Hubert Frings of the Department of Zoölogy and Entomology, have used the siren in studying the biological effects of ultrasonic sound. They discovered that white mice subjected to the sound waves died in approximately one minute, their fur absorbing the waves and converting them into heat. Mice exposed for a shorter length of time were found to be deaf, and withing a few hours their outer ears deteriorated. Roaches were killed by internal heating of their bodies, and mealworms in bran were destroyed in a similar manner in approximately 30 seconds. Flies and mosquitoes died in about ten seconds not from the heat but by being actually crushed by the sound waves.

In regard to man's susceptibility, research workers reported unusual fatigue, temporary loss of equilibrium, a tickling sensation in the mouth and nose, as well as burns, headaches, and other disagreeable symptoms when conducting their experiments with the siren. Workers in experimental laboratories where jet planes are tested report attacks of dizziness, called "supersonic sickness," when the jets are in operation. It is believed that this condition is caused by ultrasonic sound waves. Regarding the possibility of long-range death rays as a weapon of war, however, scientists rule this out as impractical, because ultrasonic sounds are absorbed readily by air.

Possible industrial uses of ultrasonic sound are varied and include the sterilization of foods, homogenization of milk, medical and surgical treatments, smoke and dust agglomeration, fog dispersal, speeding chemical reactions, and accelerating the process of aging whiskeys. In exterminating insect pests, ultrasonic sound is superior to insecticides and repellents because it is not stopped by solids or liquids but travels even faster in those mediums than in air. This opens up interesting possibilities in the control of pests in stored products.

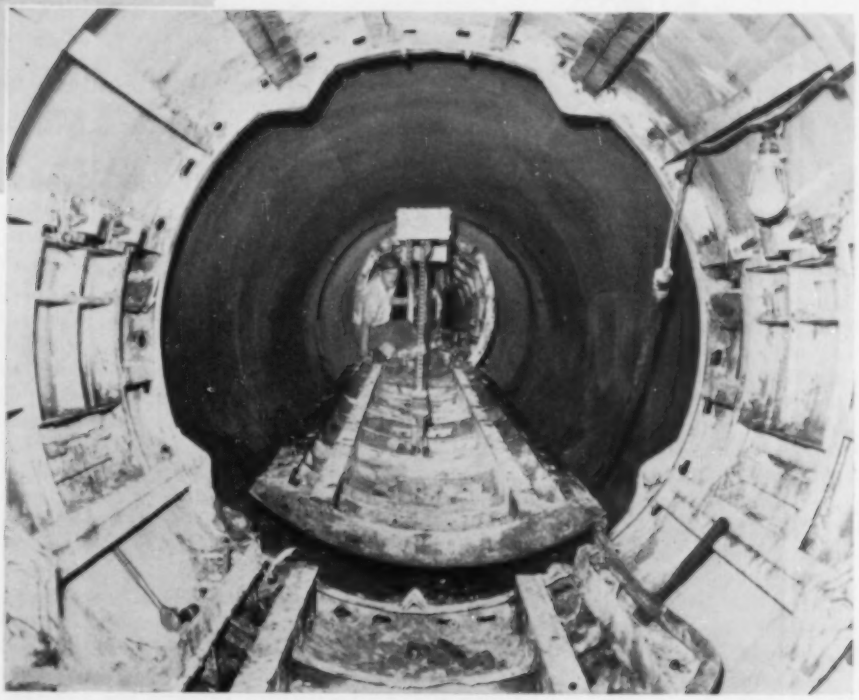




SOUND-WAVE STUNTS

The five ¾-inch glass marbles seen at the left are being floated in midair by waves of 360-cycle intensity, well within the audible range of humans, and exemplify the pressure exerted by sound waves. The siren illustrated above produces ultrasonic waves that will generate enough heat to ignite a wad of cotton in six seconds or a piece of steel wool in one minute. The picture shows a pipe being lighted.

Pneumatic Equipment Speeds Tunnel Lining



EQUIPMENT IN SERVICE

Head-on view of the rail traveler (right) showing an invert form held by the roller chain and air hoist and, in back of the operator, a collapsed arch form. In the foreground, framing the carrier, is a complete form in place. The section of the tunnel back of it has been lined with concrete. Above is a train of pneumatic placers ready to be run into the Grossmont Tunnel by a battery locomotive. Each car has a capacity of 1½ cubic yards.

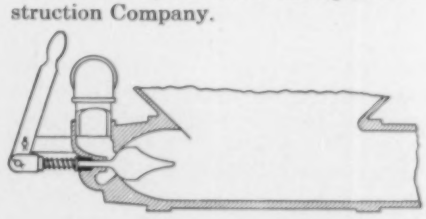
A RECENTLY completed 71-mile aqueduct is now bringing water from the Colorado River to San Vicente Reservoir located some 20 miles from San Diego, Calif. From that basin it is conducted to the city in a newly installed transmission main. One section of the latter—a 6292-foot bore known as the Grossmont Tunnel—was lined with concrete to an inside diameter of 6 feet at the rate of 100 feet a day.

That favorable advance was made possible by special pneumatic concrete-placing and form-moving equipment developed and manufactured by M. F. Kemper Construction Company. Collapsible steel forms in 20-foot sections were used and positioned by a car traveling on rails and powered by air motors. An air hoist and roller chain suspended from a beam projecting from the front end of the car served to lift and carry the single-piece invert form, while the arch form, made of five pieces hinged together, was collapsed and placed on the main frame of the traveler. Together, they were moved to the spot where they were to be set up and where steel reinforcing rings were already in position. After the invert form had been lowered on to the tunnel floor and the car run forward on rails fastened to that form, the arch form was put in place by means of hydraulic jacks mounted on the car.

Concrete was prepared in a batching and mixing plant that was set up at the intake portal of the tunnel and handled a charge made up of 37 percent sand, 30 percent 1½-inch gravel, and 33 percent 1-inch rock and pea gravel. To each cubic-yard of aggregates was added six sacks of cement and 3½ ounces of Darex air-entraining agent. The batches were dumped into a hopper and fed by gravity to 1½-cubic-yard pneumatic placers made up in trains of three each and hauled into the tunnel by a battery locomotive.

Upon reaching the pouring area, the leading placer of a train is connected to a large-diameter discharge pipe and to two smaller, paralleling air lines by means of a switching device mounted on a rail car. Air is admitted to the unit by a lever-controlled needle valve which is designed to disperse the air so as to insure thorough mixing with the concrete. Pressures to 100 psi. may be built up inside the chamber to deliver the contents into the forms at a speed ranging from half a minute to five minutes, it is claimed. After each placer has discharged its load, it is backed up a few feet and a double-acting penumatic cylinder causes a retractable set of rails to move out of the switching unit, forming a ramp over which the empty is pushed onto a track surmounting the switching device. The retractable rails are then housed and the next placer hooked up to the discharge pipe and air lines. On the Grossmont job, after all three cars had been emptied, they were hauled out by the locomotive and a full train run in.

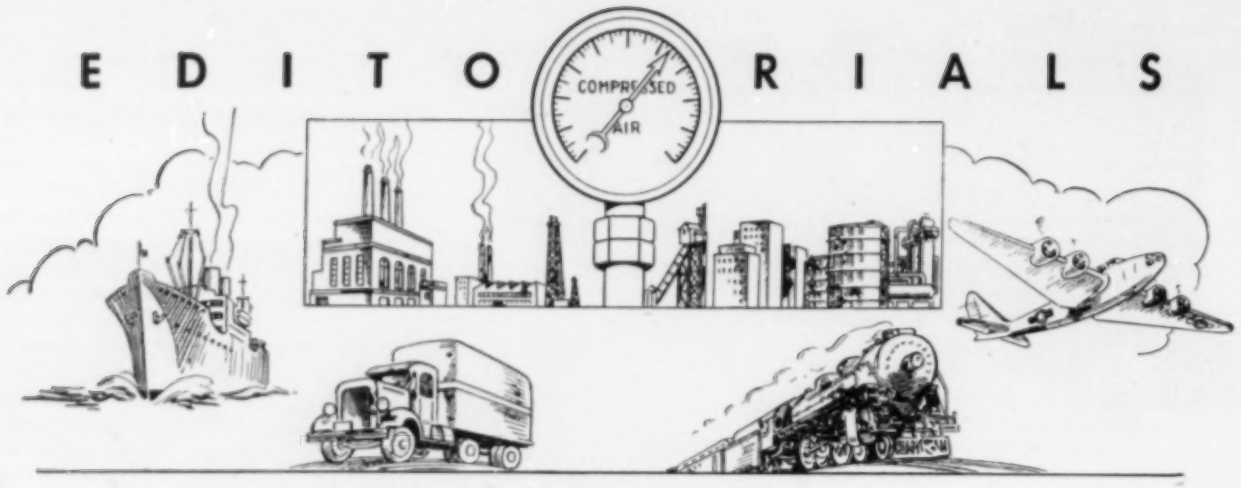
E. L. Dixon Company of Los Angeles was the general contractor on the Grossmont Tunnel, which was lined under a subcontract by the M. F. Kemper Construction Company.



DISCHARGE SECTION

Drawing shows the design of the needle valve by which high-pressure air is admitted into the concrete placer. It is located below the cone-shaped gravity-feed chamber and in line with the discharge pipe (right) which is securely locked to each placer, in turn. The valve is operated by a lever. When closed, the spherical end of the needle is held tight against the valve seat by means of a spring.

EDITORIALS



THE FUTURE ROLE OF ATOMIC ENERGY

THERE is need for a better understanding of the program being carried on by the United States Atomic Energy Commission. One reason why the public should be as well informed as possible on the subject is that it foots the bills through tax payments. A lot of money is involved, even when measured by present-day standards, and the prospects are that there will be continuing calls for large appropriations by Congress. Naturally, the attitude of the voters will have a bearing on the liberality with which the legislators respond to these requests. Another reason for spreading information is that it is the inherent right of a free people to know what its government is doing.

Contrary to popular belief, the Commission has few secrets. To be sure, it isn't divulging how atomic bombs are made. But even here only the details are suppressed, for the basic facts of nuclear fission on which the bomb depends have been available to the world for several years. This being true, mere secrecy will not safeguard our national security, because other nations can, in time, piece together the technology that will produce bombs.

Better insurance of security lies in what the Commission calls achievement. In simple words, this means adding to our store of knowledge and keeping ahead of the pack. Americans can rest assured that this course is being followed, and that it will be pursued as vigorously as possible until some workable plan of international control of the bomb is formulated and adopted by all the powers. In short, we are "keeping our powder dry."

But, although the vast intricacies of bomb-making will continue to be tightly sealed from prying eyes, there is another phase of the Commission's activities that need not be shielded from view. This concerns the efforts to probe more deeply into the mysteries of the atom's structure. Thus far the door has barely been opened, but enough has been seen to give promise of discoveries of infinite benefit to mankind.

This investigation of the "good" potentialities of atomic energy constitutes the greatest research endeavor ever undertaken. It involves the building and maintenance of huge laboratories and industrial plants and the marshaling of technological talents of every kind. The Commission inherited from the Manhattan Engineering District the structures and equipment with which the bomb was developed at a cost of two billion dollars. For the operation and expansion of these facilities, it is spending at the rate of half a billion dollars a year. It is unlikely, however, that outlays will continue at this rate, as the construction peak will be reached in 1949.

The research program has two principal divisions: The first is aimed at improving existing techniques of bomb-making all the way from mining and treating uranium ores to producing U-235 and plutonium and putting them into projectiles. These efforts are largely a continuation of the work done during the war and are closely linked with our national security. Any betterment in processes that they may bring about will, however, favorably affect the utilization of nuclear energy for non-military purposes.

The second line of investigation involves further probing of the secrets of atomic structure and determining the possibilities of applying nuclear energy in beneficial ways. The potentialities here are beyond conjecture. It has already been established that radioisotopes of such elements as sodium, phosphorus, and iodine are useful in treating some diseases of the blood and of the thyroid gland, and the opportunities for service in the field of therapy will be thoroughly explored. Introduced into animal and plant organisms, some of the radioisotopes trace the progress of chemical compounds and, hence, may reveal valuable facts concerning the nature of life processes.

Neutron beams from a plutonium reactor have marked effects on various elements and may open up entirely new vistas as to industrial materials. For example, some ordinary properties such as hardness, elasticity, and thermal conductivity of many materials are noticeably modified by neutron bombardment.

Another angle of the program relates to the harnessing of atomic energy for generating power. This can unquestionably be done, but there are many tough problems to be solved—mainly, finding materials that will not deteriorate under the physical conditions imposed and under the bombardment of neutrons to which they will be subjected. Scientists are pretty well agreed that nuclear power plants are, at the least, ten years away and will not now predict how they will compare in economy with conventional plants.

The final objective is to discover what goes on in the atom—to take it apart and see what makes it tick. To this end, various types of atom smashers of capacities heretofore unavailable are being constructed. Their potentialities of revising prevailing conceptions of the constitution of matter are boundless.

In embarking upon its multipurpose program, the Atomic Energy Commission is following the precepts of free enterprise. The Commission is solely an administrative and advisory body. All the actual work is being done under its direction by private concerns and agencies. These include industrial establishments, research organizations, and universities. The aim is to obtain the widest possible participation and thereby enlist the best technological and scientific brains and processes in the nation. Such a course also avoids any tendency towards bureaucracy.

In brief, atomic power belongs to the people, and the Commission hopes that it can stimulate broad public interest in this intriguing journey along the path towards new horizons of scientific and industrial achievement.

Throwing a Monkey Wrench into Beliefs Regarding that Tool

FROM time to time we read and hear, erroneously, that the monkey wrench derived its name from James Monckey, its inventor. Coming across this statement now and then, the writer's curiosity was aroused and he endeavored to run it down. He got in touch with editors of the publications in which the statement appeared, and they referred him elsewhere. He wrote to manufacturers of monkey wrenches, and they frankly admitted that they did not know. He searched through libraries, librarians made searches for him, but he got nowhere until someone suggested that Frank L. Coes of Worcester, Mass., might be able to provide the desired information.

Mr. Coes himself has done considerable research both here and abroad to ascertain whether a James Monckey had ever been granted a patent in this field. According to him, no trace could be found of a person bearing that name listed as an inventor or manufacturer in any country. However, it is claimed that an English patent was a very hard thing to obtain in the early part of the nineteenth century. One was issued to a Mr. Monk on an improvement for pipe wrenches, but that is neither Monckey nor the type of wrench under discussion.

Writing to Loring Coes, Frank's grandfather, late in 1865, a Mr. Trask, owner of the Trask Foundry, Springfield, Mass., stated that the term monkey wrench had been used long before that time. The latter believed that the name originated when the first English wrench was introduced. The tool was probably so called because you "twisted its tail to make it open its mouth." Mr. Trask's explanation is a plausible one. Anyway, there is nothing to prove that James Monckey invented it. Loring Coes worked for the Trask Foundry as a gear pattern maker between 1839-40 or 1840-41.

Along with this misconception of the derivation of the name there is another concerning its general application. This particular type of wrench is not universally known, sold, or purchased as a monkey wrench. In the South, except where there has been an influx of white mechanics from the North, it is not known as such. Screw wrench is the term large-scale buyers prefer. In some sections of the country they say spanner and in others screw spanner, both being direct importations from England and Scotland. Over a period of twenty years a manufacturer watched incoming orders, and not one specified monkey wrenches. That name is seldom applied when dealing with them in quantity.

Temperature Control for Dry-Cleaning Tumblers

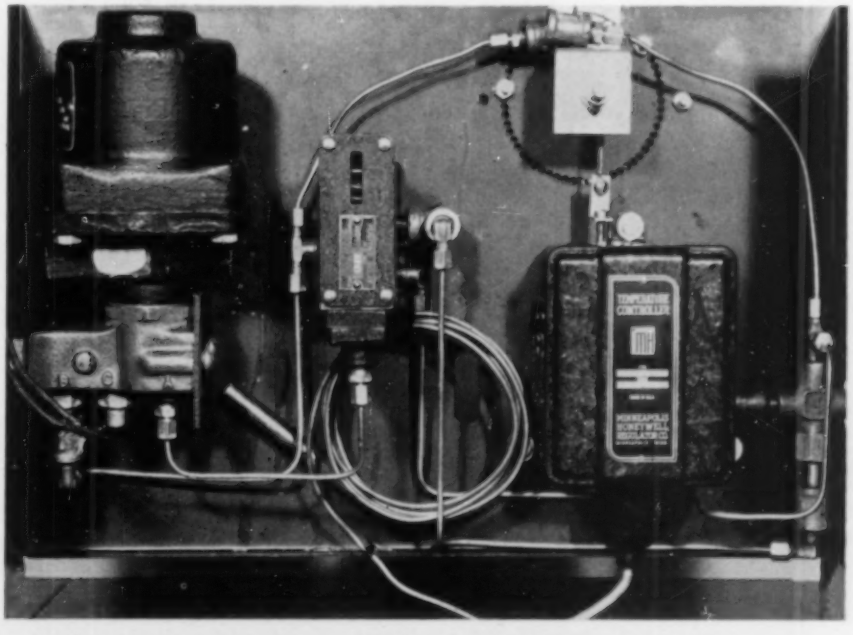
TEMPERATURES in tumblers used in dry-cleaning establishments can be regulated for each kind and weight of fabric by a pneumatic control recently put on the market. The device, designed and produced by the Brown Instrument Company, regulates the heat to which articles are exposed in the drying and deodorizing stages. It is claimed that its use materially reduces the time required for drying and also effects a considerable saving in steam.

According to the manufacturer, the maximum temperatures to which different fabrics should be subjected are: 120°F. for silks, 140° for light woolens, and 160° for heavy woolens. If these temperatures are exceeded, the materials are apt to shrink. Furthermore, substances that are incorporated in dry-cleaning solvents to impart body and luster to fabrics often harden and cause them to wrinkle excessively if overheated, thus making it necessary to do more pressing.

The use of the control obviates these conditions and, in addition, saves much time normally spent in removing spots from garments, etc. It is now the common practice to do this work by hand before the articles are washed in order to prevent setting stains permanently by excess heat. With the pneumatic control, however, only those spots that remain after the washing operation have to be removed.

Components of the pneumatic system are a temperature controller, a diverting relay, an electropneumatic relay, a temperature-setting device, and a normally open air valve, all grouped on an instrument panel that can be mounted on or near the tumbler. The valve is connected to a source of compressed air and the electropneumatic relay is wired to a switch on the door of the tumbler. When the latter is filled and the door closed, the switch energizes the electropneumatic relay and also turns on an exhaust fan that draws air through the tumbler. The air valve is then closed by the temperature controller to build up pressure in the branch air line.

When the temperature in the tumbler has reached the degree for which the system is set, the output pressure of the controller actuates the diverting relay, causing it to provide full air pressure from the branch line to close the admission valve on the steam line. The tumbler continues to function with the steam shut off until the operator stops it and opens the door, by which time the temperature within has dropped measurably. The door switch shuts off the exhaust fan and cuts off the current to the electropneumatic relay, permitting the air to escape and thus causing the steam-admission valve to reopen. The cycle is then repeated.



REAR VIEW OF PNEUMATIC CONTROL PANEL

Operator simply sets a knob on the front of the panel, and the various devices take over and automatically maintain the temperature in the dry-cleaning tumbler accordingly, thus preventing damage to fabrics through overheating. The picture shows, left to right: the electropneumatic relay, the diverting relay, and the temperature controller. The latter has a range of 105-220°F. The system is of explosionproof construction.

Scientists Investigate Rain-Making Possibilities

WITH a large percentage of the world's temperate zones short of water, scientists of various countries are intensifying research in possible rain-making techniques. It has been established that precipitation from clouds can be artificially induced under certain favorable conditions. However, where those conditions exist, rain will, it seems, fall naturally. The leading question now to be answered is whether precipitation can be brought about when conditions are against natural rainfall.

Thus far it has not been demonstrated that rain can be induced by man in really worth-while quantities. There is no authenticated instance where more than a fraction of an inch of water has been loosed from the heavens by "seeding" clouds with any of the inoculants known. Dry ice has been used most for the purpose to date, but successful experiments have been carried out with such materials as pulverized clay, volcanic ash, and silver iodide.

The primary investigations of Dr. Irving Langmuir of General Electric Company indicate that seeding creates myriads of sublimation nuclei or "ice germs," each of which may grow to an ice crystal and fall as precipitation if sufficient moisture is available. Ordinarily, however, under drought conditions, the moisture content of the air is too low to bring about the desired result. The ice crystals may start falling, but if the air be dry or the temperature above the freezing point most of them will melt and evaporate before they reach the ground.

Meanwhile, some communities are proceeding as if rain-making were an accomplished fact. In San Diego, Calif., where little more than half the normal amount of rain has fallen this year and the "dry" season is now at hand, a note of optimism is recorded. Having engaged Dr. Irving P. Krick, a meteorologist of the California Institute of Technology, to undertake cloud-tapping experiments, the city has taken the precaution to insure itself against possible flood damage. In explaining this move, City Manager Fred Rhodes recalled that rain-making tests conducted by Charles Mallory Hatfield in 1916 were followed by floods that proved expensive to the municipality.

New Microfilm Reader

USERS of microfilm readers may be interested in a new unit that differs from earlier models in that it permits easy reading as well as making facsimiles of documents without the need of a darkroom. Developed by the Scientific Instrument Division of the American Optical Company, the machine occupies 16x23 inches of floor space and has a 12¼-inch projection screen. The latter is made of a special paper permanently sealed and bonded to glass. It has no texture, and the image is therefore free from "hot spot" which is the cause of eye fatigue when reading for prolonged periods. Eye strain is further reduced by an iris diaphragm that permits each person to control the illumination to suit his vision and thus bring frames into sharp focus. Another advantage is the use of a reversible, air-cooled motor by which the film can be run at four speeds in either direction. Comfort in service is insured by scientifically designed housings for both the motor and the low-voltage lamp; and because of a new heat-absorbing glass filter in the optical system, microfilm may be left indefinitely with the lamp burning without fear of damage

CASTER MOUNTED

Unit can be switched to slow or quick scanning speed and read with ease.

PNEUMATIC TIRES PROTECT CONVEYOR BELTS

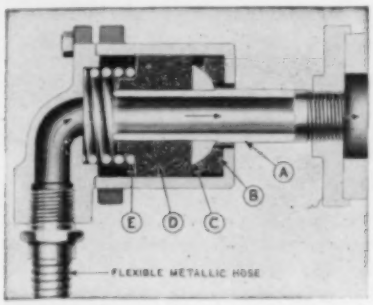
Pictured here is a Goodyear Tire & Rubber Company sales engineer demonstrating how a pneumatic-tire idler cushions the impact of falling rocks or coal on conveyor belting. The view at the left shows that even a light axe blow inflicts severe cuts on uncushioned belting. In the other picture the axe is seen rebounding from a heavy blow that did no damage to the belt because the force was absorbed by the tire. Goodyear, which has a patent on the pneumatic-tire system, claims that it has successfully protected belts against the shock of 300-pound boulders falling as much as 12 feet.

Vitamin Proportioner

ADDING vitamins to foodstuffs and beverages is now common practice and has led to the development of special facilities to prevent wastage of the expensive concentrates and to insure a product with a uniform vitamin content. Batch methods have been found inefficient and are being replaced by sanitary equipment that operates continuously and is based on the same principle as apparatus used in drug, beverage, and other industries in proportioning ingredients. One such unit is the Treet-O-Control, which consists essentially of a main-line meter through which the liquid to be treated flows. A small pilot valve, which is a part of the meter assembly, induces air impulses, and these cause the proportioning pump to add the desired amount of Vitamin C to the juice. The equipment is available in sizes to handle 3 to 180 gpm., and introduces ascorbic-acid concentrates to the flow at regular intervals; that is, within a range from 0 to 8 gpm. Multiple units may be used to add as many ingredients as processing may require. Apparatus can be readily taken apart for cleaning.

Industrial Notes

For use in paper and textile mills, and in many other processing plants, the Johnson Corporation has announced a new design of its well-known rotary pressure joint. Called the Type S, it is built to be self-supporting. Like the conventional joint, it serves to admit heating or cooling agents to rotating rolls but,



CROSS SECTION OF JOINT

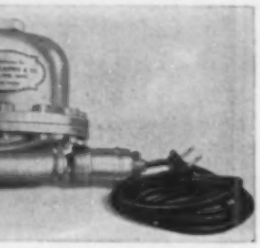
Nippel *A* is attached to the roll or cylinder; graphitic-carbon seal ring *B* fits against the rotating shoulder *C* on nipple; graphitic-carbon guide *D* supports the weight of the joint; and spring *E* is for initial seating. In operation, pressure itself is the sealing force.

because of its construction, is especially applicable where rolls have considerable lateral movement or where external piping supports cannot be satisfactorily provided. The entire weight of the joint is sustained by a large bearing or guide of graphitic carbon which is fitted inside the body and offers the rotating nipple a bearing surface. The seal proper is effected by a hemispherical collar on the nipple and another graphitic-carbon ring. Pressure itself is the sealing force—the higher the pressure, the tighter the seal. The type S comes in four sizes—from ½ inch to 1¼ inches—built for 150 psi. pressure and temperatures up to 400°F. Standard joint has cast-iron head and body with steel nipple. Others are available with bronze trim, with a bronze body and nipple, or of all bronze with a stainless-steel spring.

An automatic dividing machine that will provide any logarithmic, trigonometric, or linear scale up to 20 inches in length with an accuracy of 0.0002 inch is described and illustrated in a government report based on a visit to the factory in Germany where the equipment was built and used in manufacturing slide rules and draughtsman's scales. The Nestler machine is 21 feet long, 4 feet high, and 3 feet wide and cuts at the rate of 60 lines a minute. The scale to be engraved is mounted on a long table over which cutters in chisel form are pivoted in frames. Descending, the tools scribe lines of the desired length and then rise, after which the table moves to the next cutting position. The 53-page report (PB-79435) includes 27 drawings and photographs of various parts and mechanisms of the machine and can be obtained in mimeographed form for $1.50 from the Office of Technical Services, Department of Commerce, Washington 25, D. C.

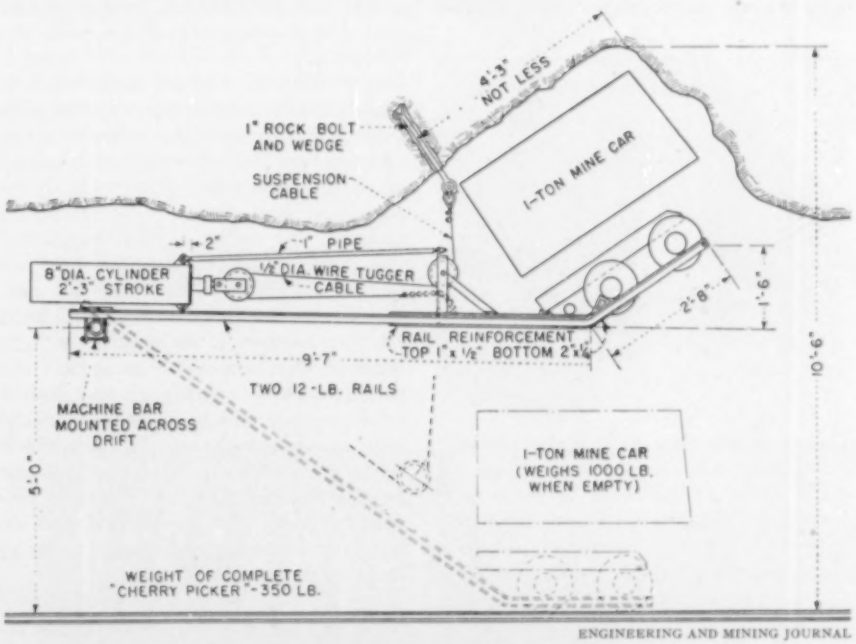
No primer is needed for LC-600, an air-drying synthetic-resin coating made by Lithgow Corporation for a wide range of uses in food-processing plants, in breweries, in pharmaceutical, chemical, paper industries, etc. It is claimed to be tasteless and odorless; positively resistant to acids, alkalies, chlorides, oils, salts, oxygen, and alcohol solutions; and suitable for application by spraying, brushing, dipping, and flowing on concrete, wood, or metal surfaces. Comes in white, industrial gray, and black.

To keep condensate in a fluid state for ejection in cold weather and to protect pneumatic tools and equipment, Jas. A. Murphy & Company converts its standard ball-float and Zip Action traps for compressed-air lines into Thermotraps by means of a newly developed heating unit. The latter consists of a 50-watt



heating element that is attached to a pipe connection on the moisture separator and plugged into a 110-volt circuit by an extension cord. It is claimed that the current prevents the condensate from freezing but is not of sufficient intensity to increase the temperature of the air lines. Installation requires no special fittings.

Engineers of the General Electric Company have developed a method of taking steel samples for analysis that cuts down to minutes, we are told, work ordinarily done laboriously by cutting a block from a solid mass and machining it into a rod. Molten metal at a temperature of 2700°F. is sucked into a sort of enlarged eye dropper made of heat-resisting glass and provided with a rubber



ENGINEERING AND MINING JOURNAL

AIR-OPERATED "CHERRY PICKER"

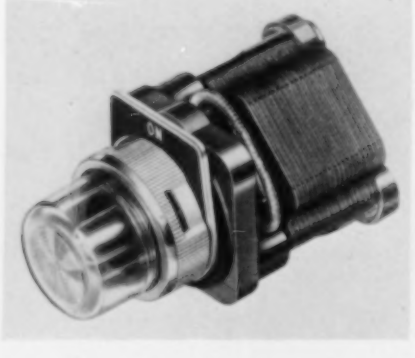
In narrow tunnels and mine drifts an empty car is often transferred from the rear to the head of a muck train by shunting it aside or overhead while backing the train. Perhaps because the car is usually picked up, such a device is termed a "cherry picker." Its use necessitates drilling and blasting a recess large enough to accommodate it, which is much cheaper and quicker than widening a stretch of the haulageway sufficiently to put in a conventional track switch. Diagrammed above is a recent variation of the cherry picker designed by R. O. Udall, assistant superintendent of Pioneer Gold Mines of British Columbia, Canada. Two 12-pound rails form the main part of the frame, which is supported aft on a bar extending across the drift. At the same end is mounted an air hoist for raising the car, as shown, by pulling on a suspension cable. It is claimed that this apparatus can be set up in ten minutes. Using it, 1-ton empties making up a train have been switched and loaded in the average time of two minutes each.

bulb. Within five minutes the steel hardens into a smooth homogeneous rod that, upon removal by breaking the tube, is ready to be cut and analyzed by an electric arc.

E-Z-Opener is the descriptive name of a one-piece casting that is made to fit over any compressed-gas cylinder valve, to which it is securely fastened by a knurled set screw. Its purpose is to seal flasks tight to prevent leakage of gas or air and yet permit opening them readily without the aid of a wrench.

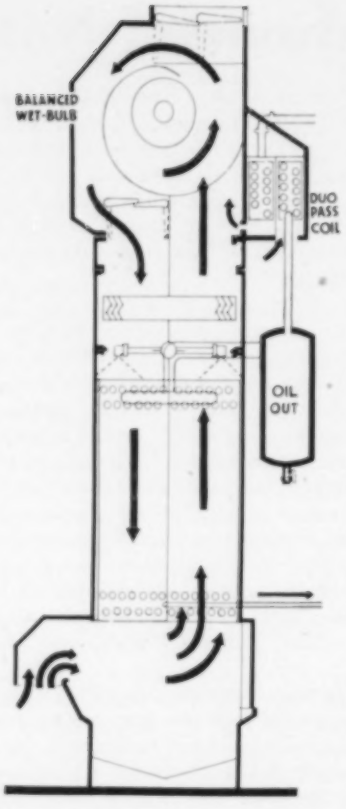
Growth of mildew on finished leather is prevented by a fungicidal dressing that has come out of the research laboratories of the U.S. Bureau of Standards. The preparation is compounded of the following ingredients: 2 percent paranitrophenol, 10 percent cyclohexanone, 20 percent of a mixture containing equal parts of neat's-foot oil and mineral oil, and 68 percent of either perchloroethylene or Stoddard's solvent.

A new oil-tight pilot light has been announced by the Industrial Controller Division of the Square D Company for machine-tool applications where cutting oils and coolants may cause a lamp of the conventional type to become inoperative. There are two models: alternating current, as shown in the accompanying illustration, and direct current. The



former has a built-in transformer permitting the use of a 6-volt incandescent bulb with a miniature bayonet-type base, and the DC has a neon lamp with a 110-volt candelabra screw base. Series resistors are utilized for higher voltages. The unit is designed for panel mounting, and caps in a wide range of colors are available.

The Niagara Blower Company has announced an Aeropass condenser of an improved type for service in refrigerating plants. The equipment, to quote the manufacturer, is designed "automatically to condense refrigerant gases and to provide trustworthy control for year-round operation at a standard minimum compressor head pressure." As the line drawing shows, condensing is effected by



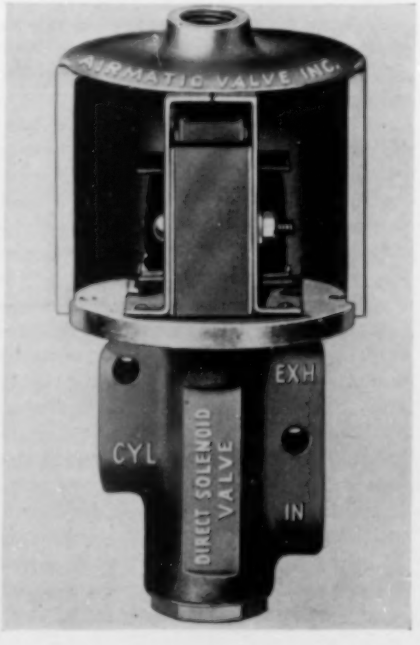
passing the gas through two coils located in an air stream. First it flows through the dry Duo-Pass, which, together with the Oil-Out, extracts superheat and condenses and separates the oil vapor from the refrigerant. Next it goes through the wet coil where it is condensed at low temperature. The latter is thoroughly drenched by a water spray and removes 1000 Btu's for each pound of water evaporated. The water is recirculated and little make-up is required. The casing is partitioned into two sections, and air-flow dampers are located internally where they are protected from the weather. Either all fresh air may be used or air may be recirculated in any proportion to permit the compressors to operate at the desired head pressure which, in practice, is the minimum required properly to distribute the refrigerant. In winter an electric heating element goes into action to prevent freeze-up. Aeropass condensers are built in units ranging in rated capacity from 10 to 100 tons.

Air at a pressure of 10 psi. is sealed inside the housing of a new lighting fixture introduced by Safe Lighting, Inc. It has been approved by Underwriters' Laboratories for service in Class 1, Groups A and B locations where explosive atmospheres present a hazard. The air holds a circuit switch in closed position and permits the lamp to burn. Conversely, pressure on bellows operating the switch is released in case of leakage and opens circuit to extinguish the light. Turning a ring nut separates the upper from the lower section of the fixture for lamp replacement or repair. Following assembly, compressed air is reintroduced through an inlet equipped with a Schrader valve.

For mining and quarrying operations and other rugged service, the Manhattan Rubber Division of Raybestos-Manhattan, Inc., has added a heavy-duty air hose to its Condor Homo-Flex line. It is made in two sizes, ¾- and 1-inch inside diameter, for working pressures of 350 and 300 psi.

Thio-Flex is a new sheet packing material for service at temperatures up to 300°F. Made of vegetable fiber with both faces coated with a thin film of Thiokol—a synthetic rubber—the material is said to effect a tight seal against water leakage, oil, aromatic spirits, gasoline, and certain solvents. It is available in rolls 36 inches wide and in thicknesses of 1/64, 1/32, and 1/16 inch. Produced by Fibreflex Packing & Manufacturing Company, Philadelphia 27, Pa., which will send samples upon request.

Airmatic Valve, Inc., has developed a 3-way solenoid-controlled air valve by which machines can be converted from manual to automatic operation. It eliminates pilots, levers, distributors, and other types of indirect control and can be used continuously, it is claimed, without harm to the valve or the solenoid. The latter's rating is 1.42 amperes inrush and .22 amperes holding at 110 volts, 60 cycles. The Model DS-3, as it is designated, can be mounted in any position, and is described as a full-capacity, high-speed, long-life valve. Internal parts are precision machined and resistant to corrosion. It comes in four standard pipe sizes from ¼ to ¾ inch.



Industrial Literature

Metallurgists and others closely connected with the metallurgical industry are eligible to receive, free of charge, a copy of *Molybdenum: Steels, Irons, Alloys* recently published by the Climax Molybdenum Company. The 391-page book describes the varied applications of molybdenum as an alloying element and covers a wide range of materials, from wrought to cast steels and from cast iron to nonferrous alloys. Major emphasis is placed on the fundamentals by which metallurgists, designers, and engineers must be guided in selecting the most suitable material for a given application. Considerable information is included on such recent developments as gas-turbine steels and alloys. Copies of the book may be obtained by writing to the company at 500 Fifth Avenue, New York 18, N. Y.

Rotary impact wrenches, both air and electric, are described in a 32-page bulletin recently issued by Ingersoll-Rand Company. It explains the principle upon which the tools work and which enables them to deliver powerful rotary blows with little or no torque reaction on the operator. Drilling metal, wood, or masonry; reaming, tapping, and running nuts; driving screws or studs; and extracting broken studs are among the jobs for which the tools may be used. The bulletin gives typical applications and the type of work for which each size of impact wrench is designed. It also lists accessories available as standard or optional equipment. Copies of Form 5200 may be obtained from the company at 11 Broadway, New York 4, N. Y.

Bulletin 73-A of Cooley Electric Mfg. Corp., Indianapolis, Ind., describes the firm's new-model electric box furnace which is designed to provide accurately controlled temperatures from 300 to 2000°F. Built to be fitted with automatic as well as manual controls, the furnace is suitable for tool and die work, production heat-treating of small parts, industrial and laboratory testing, emergency repairs, and other services that necessitate controlled heating. Drawing 20.2 amperes at 230 volts, the furnace heats from cold to 2000° in 1½ hours, and continuous operation at the latter temperature is possible.

Sixty-Six Practical Ideas for Metal Problems in Electrical Products is the title of a publication obtainable from The International Nickel Company, Inc., 67 Wall Street, New York 5, N. Y. The 36-page publication deals with special operational difficulties such as high temperatures, corrosion, formability, abrasion, fatigue strength, magnetostriction, etc. Approximately 100 stories, in nontechnical language, tell about the problems that confront the designer of electrical equipment, list his reasons for selecting a nickel alloy, and give facts about the performance of equipment in actual service.

A 12-page technical bulletin has been issued by Progressive Welder Company explaining how its welding guns can be adapted for different jobs by interchanging standardized parts such as jaw extensions, electrode holders, air or hydraulic operating cylinders, switches, etc. These may be assembled on any one of five basic types of chassis to provide a gun of well-nigh any shape. Requests for copies of the bulletin should be addressed to the company at 3050 East Outer Drive, Detroit 12, Mich.

Allis-Chalmers Manufacturing Company, Milwaukee 1, Wis., has published a 12-page bulletin to serve as an aid in the selection of electric motors. Detailed specifications,

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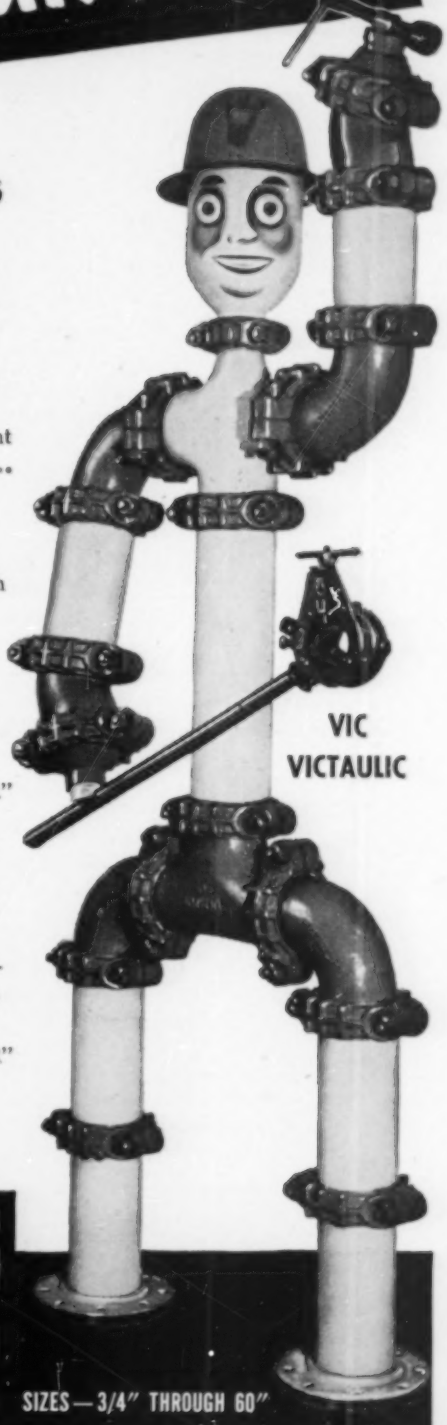

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JUST A FEW TWIRLS of a T-wrench buttons up a Victaulic system...or unbuttons it—with no special skill or training needed!

THIS SAVES YOU money, man-hours, material...in assembly, repair, or salvage!

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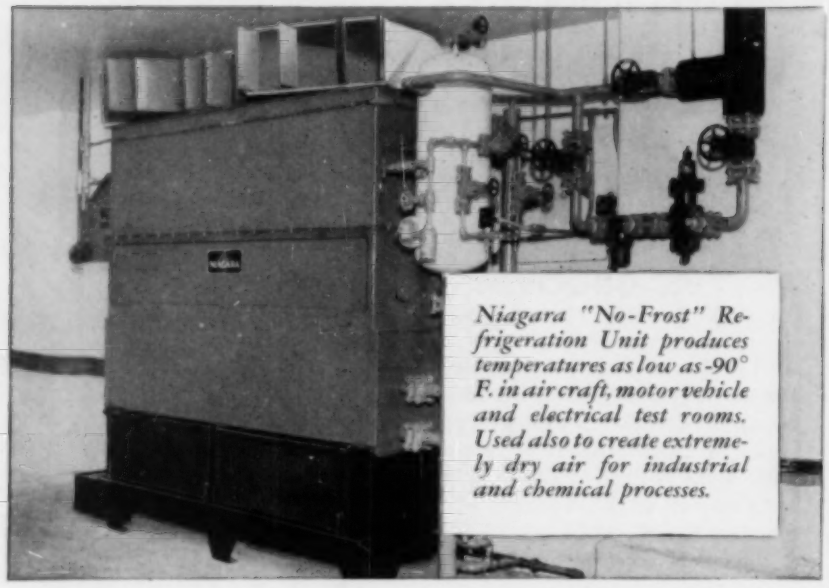
INCREASED PRODUCTION AND A MORE UNIFORM PRODUCT WITH A *Controlled Atmosphere*



Niagara "No-Frost" Refrigeration Unit produces temperatures as low as -90° F. in aircraft, motor vehicle and electrical test rooms. Used also to create extremely dry air for industrial and chemical processes.

● A controlled atmosphere may be a particular gas, inert or reactive, or it may be air under controlled conditions of purity, temperature or moisture content. Its purpose is to further production or prevent loss of material or product, or to make a uniform and better product.

This Company has worked for many years among such problems and has developed special apparatus that has helped many industrial leaders to improve their manufacturing.

Always, there is a problem of moisture and temperature, whether it may be a special gas atmosphere for heat treating, or air under most precise specifications for a process with hygroscopic materials, or a "cold test" room at -90° F.

Niagara Units for industrial air and gas conditioning make it easier for you to find equipment that will produce the conditions you need with both installation and operating economy.

Write for a Niagara Blower Bulletin on a subject which interests you, or for the address of the nearest Niagara Field Engineer.

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application data, speed-torque curves, and size ranges are given for squirrel-cage induction motors, as well as synchronous, wound-rotor, and direct-current motors. The bulletin also covers the uses and features of gear motors and multispeed induction motors. Interested persons may secure copies by requesting Bulletin No. 51B6052J.

A 4-page bulletin has been issued by Western Manufacturing Company, 3400 Scotten Avenue, Detroit 10, Mich., describing its line of transmissions. Ranging in size up to 30 hp., they may be used for motorizing lathes, milling machines, shapers, and other machine tools.

Bausch & Lomb Optical Company has prepared a catalogue describing and illustrating its new Model L photographic equipment. Designed for visual and photographic work at high or low power and with either transparent or opaque specimens, it can also be used as a copying camera. Interested persons may obtain further details by writing to the company at Rochester 2, N.Y., for Catalogue E-210.

Users of flexible couplings may secure a 24-page catalogue—No. 48—recently published by Ajax Flexible Coupling Company, Inc., Westfield, N. Y., and containing working data on its line. Covered in addition to the standard types are shear-pin, brake-drum, bolt-on, and detachable-hub couplings. Data are given on forged steel and cast semisteel construction, and capacities and dimensions are included for the various sizes.

B. F. Goodrich Company, Akron, Ohio, will send upon request a folder containing data on flexible couplings for direct-connected drives. The descriptive material includes a table by which the right size coupling can be selected for each application.

Mechanical flow meters based on the ring-balance principle of operation are described and illustrated in Bulletin 2M48 issued by Hagan Corporation, Hagan Building, Pittsburgh 30, Pa. Reported features of the principle are maintenance of high accuracy at low flows, recalibration by the dead-weight method or by a water column, and ease of adjustment. Models manufactured include recording and indicating flow meters, indicating-integrating flow meters, steam flow-air flow boiler meters, dual-type meters, and units for special applications.

Silicone mold-release agents for rubber and plastics are described in a 16-page bulletin obtainable from Dow Corning Corporation, Midland, Mich. In addition to giving the agents' general properties, the booklet lists and illustrates a number of their major applications in the manufacture of tires, mechanical rubber goods, floor tile, plastic products, and other items. Copies will be sent to interested persons upon request.

Louis Allis Company, Milwaukee, Wis., will send upon request Bulletin 711 which describes its latest sanitary electric motor for use in dairies and food-processing, canning, and beverage plants. Its outer surfaces are free from cracks, recesses, or depressions in which milk or other foodstuffs could collect. The small sizes feature totally enclosed, nonventilated construction to keep out dirt and vermin. Larger models are splashproof and have removable grille plates over the inlets and outlets to exclude vermin. All have built-in conduit boxes, and the entire base is enclosed in the motor housing and finished to a flat surface to prevent liquids or food particles from collecting under the motor.

New small-tool air hose by B. F. Goodrich cuts 50% weight from hose line

Highflex air hose is more flexible, lighter, stronger

IN NEW Highflex small-tool air hose B. F. Goodrich introduces to the pneumatic tool field a revolutionary small air hose that's lighter and many times more flexible than ordinary hose. Lighter hose line is flexible as a lamp cord. Weight-saving thinner wall is stronger than ordinary hose of equal capacity. Oilproof inside and out. Here's how Highflex is *four* ways better.

1. It's 50% lighter — Highflex averages more than 50% lighter than ordinary type air hose. A ¼" hose of ordinary design weighs 20 lbs. per 100 ft. Highflex air hose weighs only 8.8 lbs. per 100 ft. Similar savings in all sizes.

2. More flexible, easier to handle — Because it's lighter, Highflex makes the tool line easier to move, to use in close quarters, to drag 'round corners, to keep kinkless. Flexible as a lamp cord, this light-weight hose reduces operators' fatigue, makes air tool operations faster, more economical.

3. High burst strength — Working pressures with Highflex go as high as 250 lbs. with complete safety — a wide margin for any small tool. Hose braid scientifically designed for strength at the angle of maximum stress. Tube and braid designed for minimum expansion under pressure.

4. It's oilproof — Lubricating oil won't affect your Highflex line — it's oilproof inside and out. Won't swell to cut air pressure or volume. Won't flake off and cause the tool to jam or choke with rubber particles. Proof of the oilproof quality of Highflex: it's actually used in the petroleum industry for conveying oil!

Other advantages of Highflex over ordinary air hose: cover compound that won't tear or snag easily; less line weight to cause abrasion; resists sun "checking"; takes up less storage space; attractive red cover of high visibility. Full details from your local distributor, or write: *The B.F.Goodrich Company, Industrial Products Division, Akron, Ohio.*

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COOK'S SEGMENTAL COMPRESSOR RINGS

FOR FULL CAPACITY AND MAXIMUM AVAILABILITY

On the tough jobs in the chemical and natural gas industries, where availability and maximum efficiency is so important, the Cook Style 104 Segmental Compressor Rings, illustrated, are rapidly becoming the standard. This is evidenced by the fact that these rings are used by many compressor manufacturers and specified by purchasers of new equipment to the tune of many hundreds of thousands H.P. during the past several years.

This ring style was introduced many years ago, and has been continually improved through constant refinements in materials and in methods of precision manufacture of both ring and spring. Today it enjoys great popularity because it provides maximum seal, longer life, and reduced cylinder wear.

Once the piston is grooved to take Cook 104 Rings, the selection of the most suitable ring for any specific service is greatly simplified, since they are available in a wide choice of materials of time-tested, wear-resisting properties.

If you want the finest in piston rings, specify Cook 104 Rings when ordering new equipment. For existing units, contact our nearest office.

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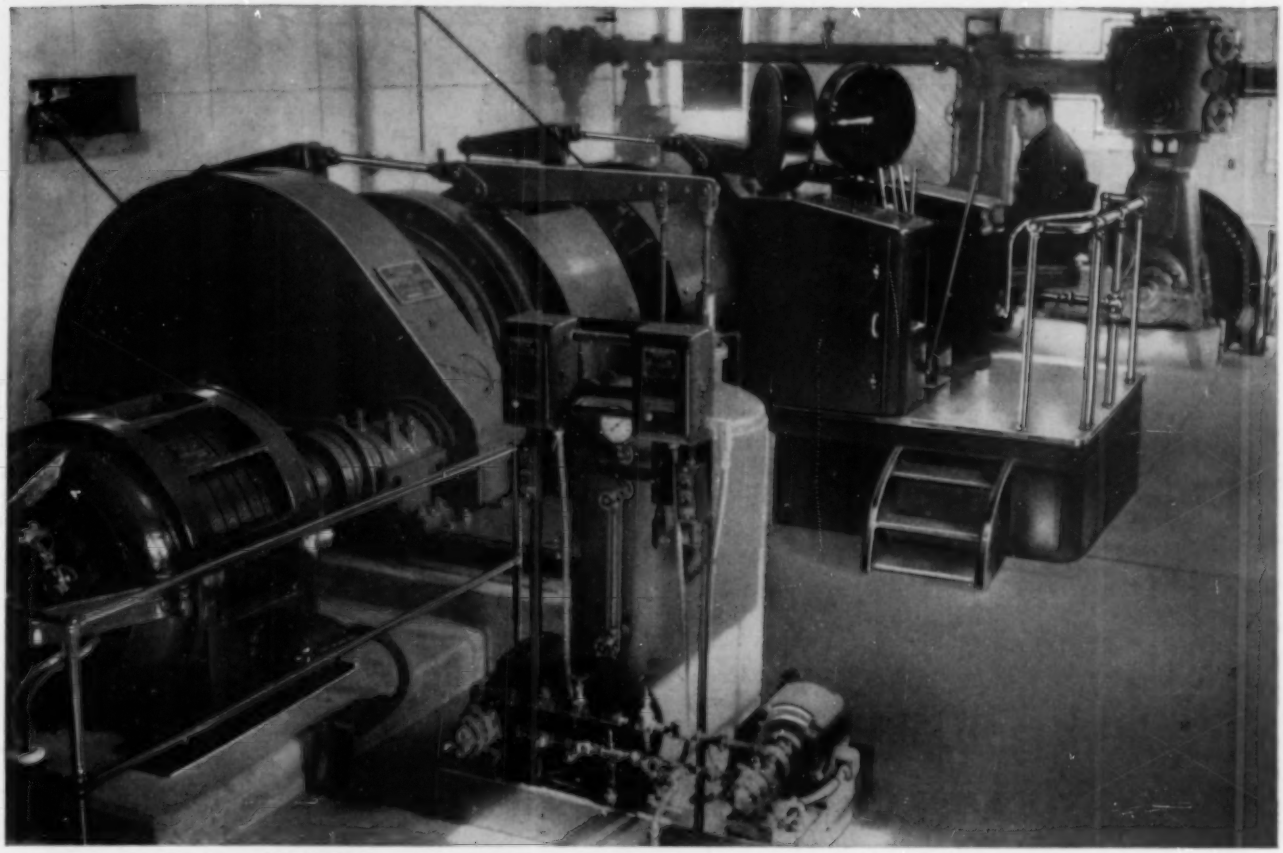
BALTIMORE • BOSTON • CHICAGO • CLEVELAND • HOUSTON • LOS ANGELES • MOBILE • NEW ORLEANS • NEW YORK • SAN FRANCISCO • TULSA



Canadian Barite Aids Oil Well Drillers at Home and Abroad

Canadian Industrial Minerals Limited, a subsidiary of Springer Sturgeon Gold Mines, has added "Cimbar"* or barite, from Nova Scotia, to the list of industrial minerals produced in Canada for domestic and overseas trade.

Barite, sometimes called heavy spar, is used as a "weighting material" for oil well drilling in Canada, the United States, Trinidad, Venezuela, Ecuador and other countries. It is also used to make lithopone for the manufacture of paints, rubber goods, floor coverings and other products.

* Trademark

View showing the Canadian Ingersoll-Rand Size 60" x 36" Class PE-1 Double Parallel Drum, Single Reduction Geared, Electric Mine Hoist installed at Canadian Industrial Minerals Limited, Walton, Nova Scotia. This hoist is equipped with Enclosed Platform Desk Control, Model D Lilly Controllers and Oil-operated Axial Plate Clutches and Post-type Brakes. The Oil Accumulator and Dual Pumps with push-button starters are shown in the foreground. The hoist is driven by a 250 hp., 600 rpm., 550 volt, 3 phase, 60 cycle motor with full magnetic control.

HOISTING CONDITIONS

	Initial	*Ultimate*
Shaft Depth	700′	700′
Hoisting Speed	765 fpm	920 fpm
LOADS		
Ore	5000 lbs.	6394 lbs.
Rope 1"	1106 "	1106 "
Unbalanced load . . .	6106 "	7500 "
Combined cage and skip	5500 "	5500 "
Load on one rope	11606 "	13000 "
Other cage and skip	5500 "	5500 "
Other rope	1106 "	1106 "
Suspended load	18212 "	19606 "

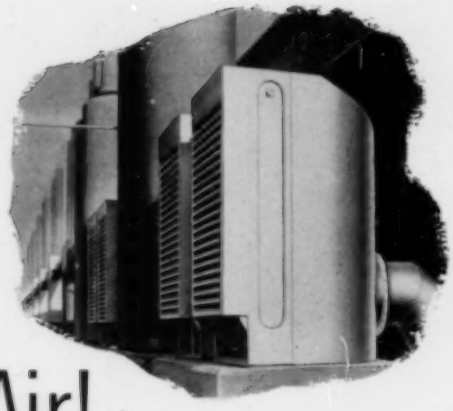
K-15

C-I-R Mine Hoists are manufactured in sizes for every service - - from initial shaft sinking and light development work to the heaviest types of deep-level hoisting. Further information may be obtained from Ingersoll-Rand branches throughout the world.

Canadian Ingersoll-Rand Company Limited

HEAD OFFICE-MONTREAL, QUE. — WORKS-SHERBROOKE, QUE.

BRANCH OFFICES: SYDNEY, SHERBROOKE, MONTREAL, TORONTO, KIRKLAND LAKE, TIMMINS, WINNIPEG, CALGARY, NELSON, VANCOUVER



SAVINGS... right out of the Air!

AAF Multi-Duty Type CMS Filters keep dust out and maintenance costs down

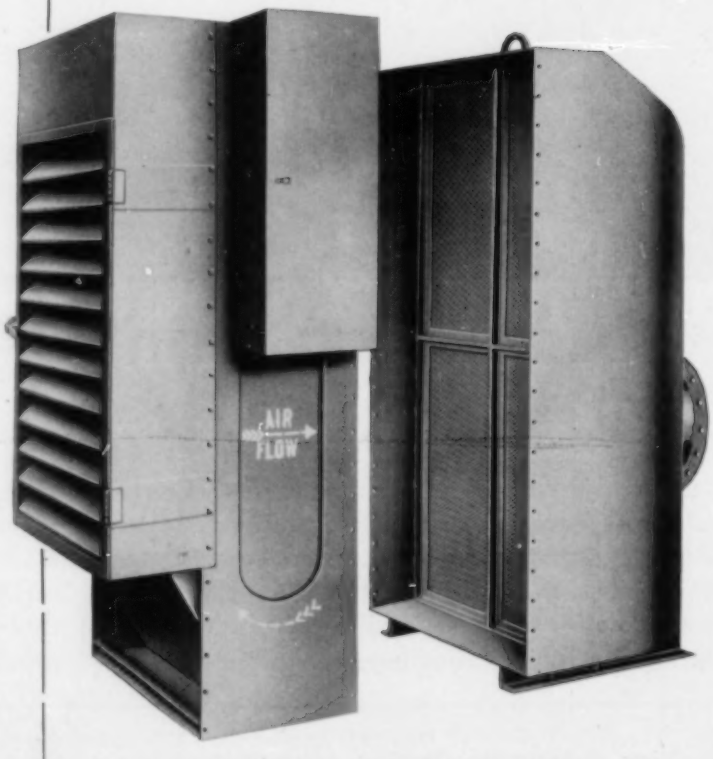
AAF protection pays dividends! That's why Multi-Duty Air Filters are selected to guard costly engines and compressors against the damaging effects of dust.

Even the most severe "dust bowl" service doesn't phase the AAF Multi-Duty. Its overlapping panel curtain provides both a positive, trouble-free self-cleaning operation and a uniform volume of clean air. Operating resistance of filter remains fixed when once set for a given dust condition. The only care required other than regular inspection is the periodic removal of sludge.

For outdoor installation, the Type CMS filter is furnished as a housed unit. Front louvers protect the filter curtain. Engine or compressor intake is connected to a compact plenum chamber with perforated metal baffle inside to dampen intake pulsations and distribute air flow evenly over the entire curtain area of the filter.

Savings, safety and dependable service—you'll get all three with an AAF Multi-Duty Self-Cleaning Air Filter on the job. Write today for complete information.

AMERICAN AIR FILTER COMPANY, INC.
402 Central Avenue, Louisville 8, Ky.
In Canada: Darling Bros., Ltd., Montreal, P.Q.



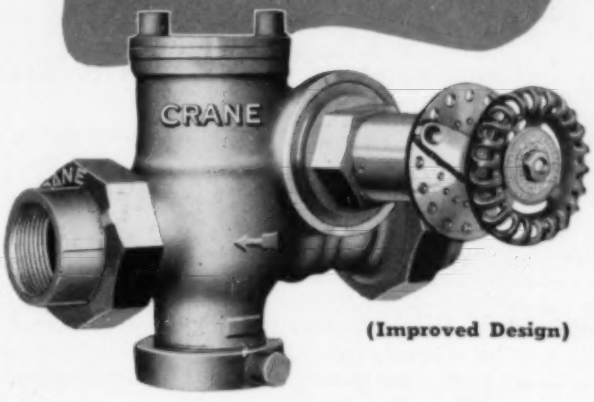
FREE BULLETIN!

Send for your copy of Bulletin No. 150, describing the Multi-Duty Type CMS Filter.

AAF

AIR FILTERS
AND DUST CONTROL EQUIPMENT

AVAILABLE FOR IMMEDIATE DELIVERY . . .



(Improved Design)

NO. 960 BRASS PRESSURE REGULATOR

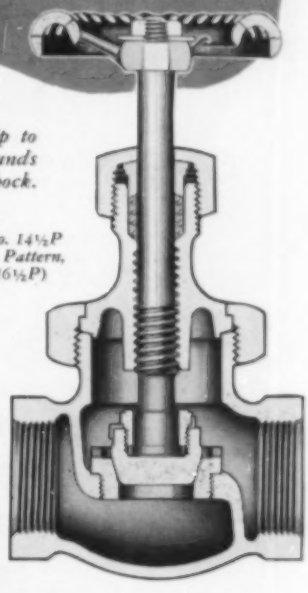
1. For initial steam or air pressures up to 250 lbs., reduced to within 80%. Sizes up to 2 in.
2. Can't wear out; every working part is renewable. Piston operates in removable cylinder liner.
3. Can be furnished for any of four service pressure ranges: 1 to 10, 5 to 30, 20 to 100, 90 to 200 pounds. Setting within each pressure range is by simple hand-wheel adjustment. Operation is completely automatic.
4. Maintains uniform reduced pressure at all times. Pressure cannot build up.
5. Simplified design: has minimum working parts. Fully accessible for inspection. Easy to service.

How to Choose the Right Size

For best results, having the right size pressure regulator for your needs is all-important. Get this folder with its handy size selector, and other data to help you order. Or, see your Crane catalog, p. 410-411.

WRITE FOR DESCRIPTIVE FOLDER AD-1597

BEST FOR TOUGH SERVICES!



Working Pressures: *Up to 150 pounds steam; 300 pounds cold water, oil, or gas, non-shock.*

Cat. No. 14½P (Angle Pattern, No. 16½P)

150-POUND PLUG TYPE DISC BRASS GLOBE AND ANGLE VALVES

WHERE TO USE THEM

Recommended for all spots where flow is throttled, and where operating conditions are severe. Ideal for soot blower, blow-off, boiler feed, drip and drain lines.

WHY THEY GIVE BETTER SERVICE

They are designed throughout for tough work. Plug type disc and seat provide extra-wide bearing surfaces for maximum resistance to wire-drawing and damage by foreign matter. Taper of disc permits easy regulation of flow.

Seating materials (Crane Nickel Alloy to Exelloy) are harder, tougher, and stronger than metals ordinarily used in brass valves. They have higher resistance to wear, temperature, galling, and scoring. See your Crane catalog, p. 31 or

WRITE FOR DESCRIPTIVE CIRCULAR AD-1668

CRANE CO., *General Offices,* 836 South Michigan Avenue, Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

EVERYTHING FROM . . .

VALVES
FITTINGS
PIPE

CRANE

PLUMBING
AND
HEATING

FOR EVERY PIPING SYSTEM

MADISON-KIPP *Fresh Oil* LUBRICATORS

Smooth and continuous operation hinges on the lubrication system. Fresh oil, by the measured drop, from a **MADISON-KIPP** Lubricator is the most dependable method of lubrication ever developed. It is applied as original equipment on America's *finest* machine tools, work engines and compressors. You will definitely increase your production potential for years to come by specifying **MADISON-KIPP** on all new machines you buy where oil under pressure fed drop by drop can be installed.

"Our 50th Year"

MADISON-KIPP CORPORATION

202 WAUBESA STREET, MADISON 4, WISCONSIN, U. S. A.

ANCIENS ATELIERS GASQUY, 31 Rue du Marais, Brussels, Belgium, sole agents for Belgium, Holland, France, and Switzerland.

WM. COULTHARD & CO. Ltd., Carlisle, England, sole agents for England, most European countries, India, Australia, and New Zealand.

- *Skilled in* DIE CASTING *Mechanics*
- *Experienced in* LUBRICATION *Engineering*
- *Originators of Really High Speed* AIR TOOLS

Drill Steel

THAT STAYS ON THE JOB

Your best insurance against drill steel failure is to standardize on Bethlehem Hollow. The hardenability of this fine steel is closely controlled in the steelmaking process. It must pass rigid inspection at every stage of its manufacture. That's why you can rely on it to stand the rapid pace of modern rock-drilling schedules.

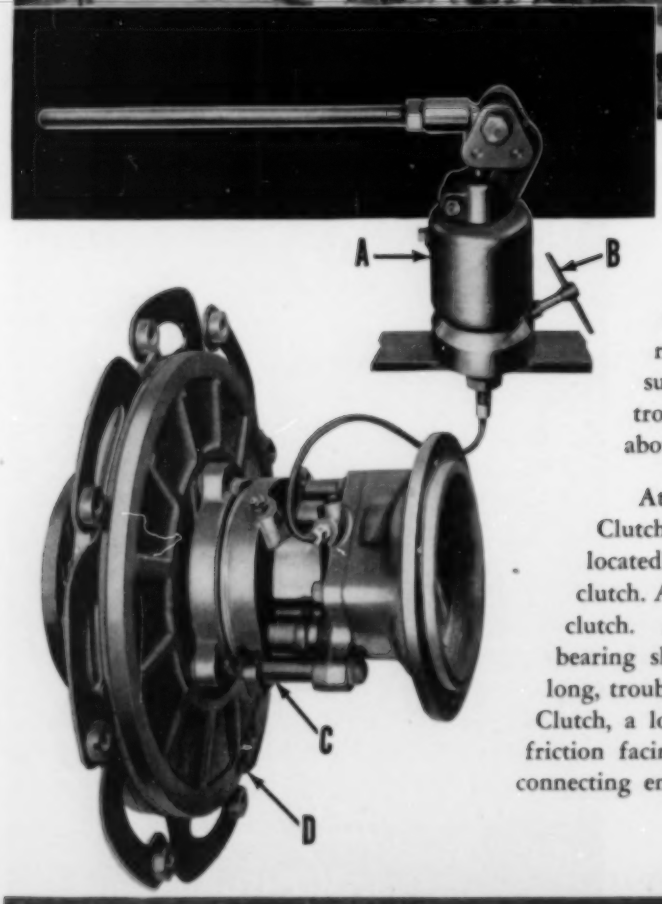
- Bethlehem Hollow is uniform from bar to bar.
- It forges readily to close dimensions... for tough shanks, sharp bits, and long-wearing threads.
- Its wide quenching-ranges make it easy to heat-treat for the ideal hardness, wear-resistance and shock-resistance.
- It has a center hole that is smooth and true.
- Best of all, Bethlehem Hollow stays on the job... keeping your costs down.

Next time ask for Bethlehem Hollow, not just "drill steel." Immediate delivery in all standard sizes—from our mill or your nearest supplier.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM HOLLOW DRILL STEEL



Above ground in New York these three I-R *Mobil-Air* Compressors run unattended all day while—

Below ground in the Brooklyn-Battery Tunnel men with wagon drills and jackhammers break through the rock foundation of Manhattan Island. Unfailing air supply to their tools is assured by hydraulically controlled *Flex-Disc* Clutches with which the compressors above them are equipped.

At the left is the new *Hydro-Shifter* for *Flex-Disc* Clutches. Pump reservoir (A) can be conveniently located. 2 or 3 strokes of the handle disengage the clutch. A one-eighth turn of release valve (B) engages clutch. A dual hydraulic jack unit (C) with ball bearing shift collar actuates the clutch and assures long, trouble-free service. This (D) is the *Flex-Disc* Clutch, a low upkeep clutch designed so that worn friction facings can be replaced easily without disconnecting engine from compressor.

INDUSTRIAL CLUTCH CORPORATION

Waukesha Wisconsin

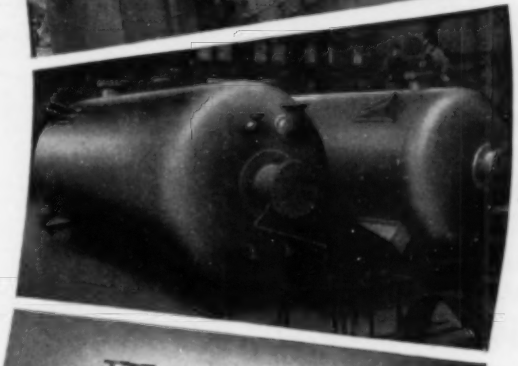
USE THESE BETTER

Vogt Products

For Today's Tough Service Demands

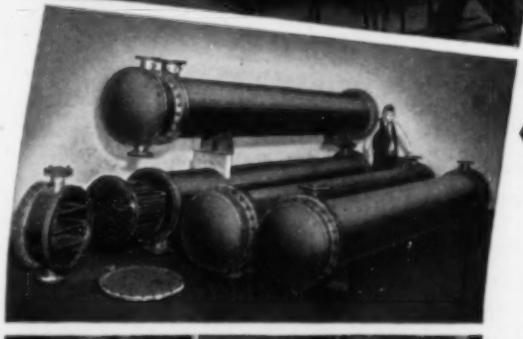
EFFICIENT AND DEPENDABLE STEAM GENERATION

Vogt steam generating units are designed to give maximum rating in a minimum of space with high efficiency and low maintenance expense. Bent tube types and straight tube, forged steel sectional header types to burn solid, liquid or gaseous fuels, as desired, meet every power, heating or process requirement.



PROCESS EQUIPMENT FOR EVERY SERVICE

Stills, towers, oil chilling machines, filter presses, heat exchangers, etc. are constructed to all Codes. They meet all demands for operating security and trouble-free performance and help to lower costs in important process industries around the world.

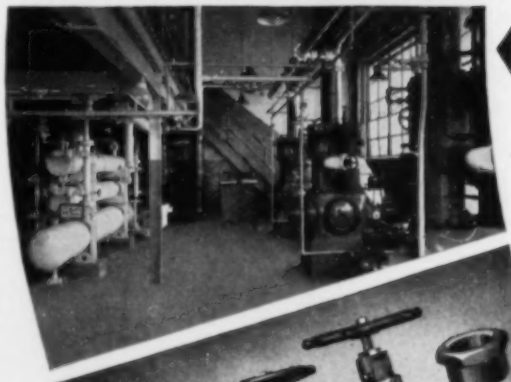


SPECIAL MATERIALS FIGHT CORROSION AND PRODUCT CONTAMINATION

Our modern shops produce a wide variety of equipment made from special metals and alloys to combat corrosion, and product contamination or discoloration. Fabrication procedures employed insure that corrosion resistant properties of welds will match that of the materials from which units are constructed.

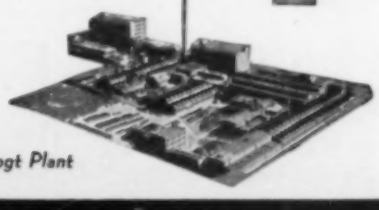
MORE TONNAGE AT LESS COST

Over 60 years of manufacturing experience, engineering and research stand behind Vogt refrigerating and ice making machinery. Absorption Systems, Compression Systems, and the Automatic Tube-Ice Machine in a wide range of capacities serve in leading petroleum refineries, chemical plants, ice and cold storage plants, dairies, packing plants, etc., at home and abroad.



DROP FORGED FOR EXTRA TOUGHNESS AND LONG-TIME SERVICE

Vogt valves, fittings and flanges, for top performance in oil, water, air, gas, and ammonia services, at high or low pressures and temperatures, are available drop forged entirely from carbon steel or stainless steel. Valves can be furnished in a combination of materials by using stainless steel for parts affected by service temperature or corrosion, and less expensive alloys or carbon steel for other parts.



Air View of Vogt Plant

HENRY VOGT MACHINE CO.

LOUISVILLE 10, KENTUCKY

BRANCH OFFICES: NEW YORK, PHILADELPHIA, CLEVELAND, CHICAGO, ST. LOUIS, DALLAS

Here's *New* Digging Power! with the *New* I-R Size 159

The tops in diggers is the new Ingersoll-Rand 159—the fastest—easiest to handle—lightweight digger you've ever seen.

Here's why:

- **Tops in Power—Power not dependent on nozzle-steel seal.**
- **Easy to Hold—Operator only guides, not fights, this digger.**
- **Light in Weight—Weighs only 37⅝ lbs.**
- **Smoother Operation—Cushion type piston.**
- **Positive Steel Control—Latch type retainer.**
- **Accurate Alignment Assured—Through-bolt construction.**

See it in action. Call our nearest branch office to have one of our Service Engineers arrange a convincing demonstration of this spectacular new digger on one of YOUR jobs. The Size 159 Digger is excellent for digging in hard pan, frozen ground, coarse gravel and shale. The sooner you see it in action, the sooner it will be at work for YOU.

Demand the IR CONTRACTORS' COMBINATION

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y. 253-B

Top quality machines that work as a team and enable the workman to do more work with less effort. Ask one of our representatives to show you how Air Tools pay for themselves nearly twice as fast under today's conditions. Machines designed, built and serviced by men who know contracting.

...belt man Howard Smith was tired but happy...

[A play-by-play description of Houghton service that re-started a stalled steel mill]

...weighed 3250 pounds total.

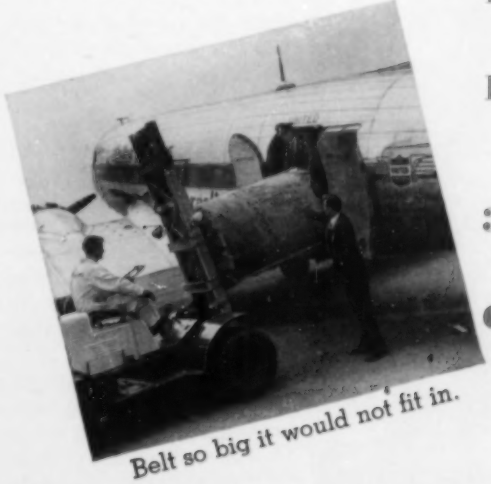
1:15 A M —Phone call from Ohio mill to Houghton Leather Sales head J. N. Smith: "Send us those spare belts you've been storing for us. Hurry, we're shut down!"

1:20 A M —J. N. Smith calls Factory Supt., C. H. Butler, who in turn calls his assistant, Bill Egenolf, and foreman, W. Lyall, to get a crew together at once.

3:00 A M —Six belt makers arrive at the Houghton plant to trim, roll and wrap belts for shipment.

8:00 A M —Belts ready to load on truck. They were 158 and 105 feet long, five feet wide, together weighed a total of 3250 pounds.

10:00 A M —Plane chartered to fly belts and installation man, Howard Smith, to Ohio.



Belt so big it would not fit in.

12:15 P M —Plane door was too small to permit loading of belts. Larger plane could not land on steel mill city airport, so at—

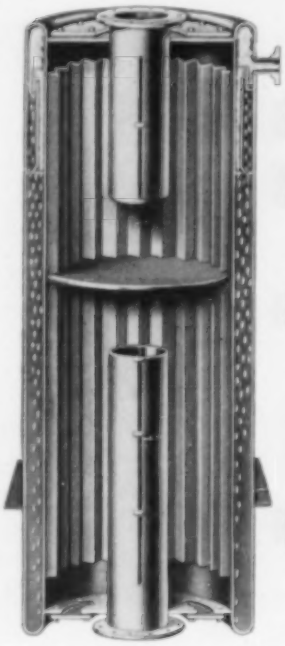
3:20 P M —Belts and Belt Man Smith loaded on truck, ready to leave for jolting ride to Ohio.

6:10 A M (***next day***) —Belts arrive at mill and installation begun. Mill out of production (and Belt Man Smith out of sleep) only 48 hours.

●

Users of air compressors, like steel mills, buy belts on cost per unit produced, be it a pound of air or ton of steel. Compressors are a tough drive, the kind that VIM Leather can handle. May we prove it? E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33, Pa.

HOUGHTON'S
VIM TRED LEATHER BELTING



WASTE EXHAUST HEAT MAKES STEAM OR HOT WATER WITH THE MAXIM HEAT RECOVERY SILENCER

Wherever Diesel or gas engines are used, an important dollars and cents amount of heat goes out the exhaust pipe, totally wasted. This heat transformed into steam or hot water by Maxim Heat Recovery Silencers could be used for heating or processing operations — without any added fuel cost.

Maxim Heat Recovery Silencers provide all-important silencing (and spark arresting where necessary), but in addition they enable you to put your exhaust heat to work . . . make more efficient use of the fuel you buy.

Sturdily constructed for heavy service, they can run wet or dry without harm — steaming rate can be automaticalty controlled. For greater operating efficiency investigate Maxim Heat Recovery Silencers.

THIS STORY MAY SAVE YOU MONEY

Send for our new
Heat Recovery Bulletin WH-101

THE MAXIM SILENCER CO.
61 HOMESTEAD AVE.
HARTFORD 1, CONNECTICUT

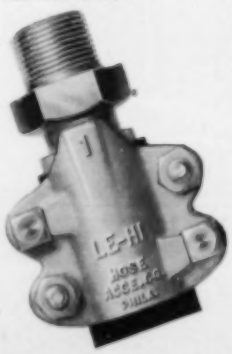
BE SURE IT'S A

MAXIM

There's NO PRESSURE DROP on HIGH PRESSURE LINES when LE-HI HOSE COUPLINGS ARE CARRYING THE LOAD

LE-HI Series 100 Universal Type Hose Couplings. Applicable for compressed air and many special uses where a quick detachable coupling is desirable.

LE-HI Series 400-W and G Female Washer or Ground Joint Type Coupling with I.P.T. Spud. Sizes ¾" and smaller furnished with two-bolt clamp and 1" and larger with four-bolt clamp.



LE-HI Series 500 Male Hose Coupling, companion unit for LE-HI Series 400-G and 400-W. It is completely adaptable to the widely diversified applications where the female units are used.

Ever stop to think how much it costs you every time your compressor runs full time . . . without cutting in and out?

Compressors and other primary equipment have to work "overtime" too often because of leaks caused by faulty hose couplings and fittings. Guard against pressure drop and loss of expensive power by using LE-HI Hose Couplings on your hose lines. Put the wear and tear on LE-HI . . . not on the equipment that costs thousands of dollars.

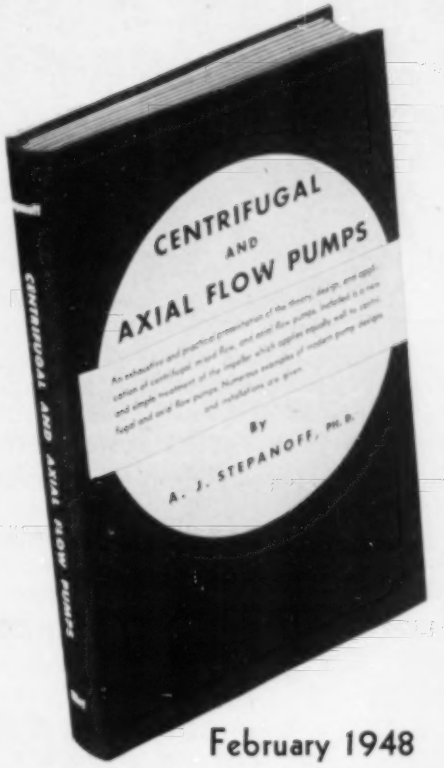
For example, on air compressors, pile driving equipment, road pumps, jetting pumps, and other hydraulic equipment, or for conveying air or steam under high pressure, specify LE-HI Series 400 and 500 Hose Couplings. Powerful clamps grip the coupling securely to the hose so that it will not leak or blow off.

Avoid pressure losses and costly shut downs. Specify LE-HI . . . a diversified line of hose couplings for industrial and construction use.

Sold Only
THROUGH DISTRIBUTORS

HOSE ACCESSORIES CO.
2716 North 17th Street, Phila. 32, Pa.

LE-HI
HIGH and LOW PRESSURE
HOSE COUPLINGS



NOW...

First Book-length Study

of

CENTRIFUGAL AND AXIAL FLOW PUMPS

By A. J. Stepanoff, Ph. D., *Ingersoll-Rand Company*

A study of centrifugal and axial flow pumps that's *not* just a discussion of elementary theory. It is one of the most complete working manuals ever available to pump engineers in this country.

Theory, design and application are the three broad divisions of the book. In the first five chapters, Dr. Stepanoff covers the theoretical background necessary for understanding recent developments. Chapters Six through Twelve are devoted primarily to design, including impeller and pump casing design, losses in centrifugal pumps axial thrust, cavitation, and pump design for critical speeds. Finally, the author discusses the problems encountered in operating centrifugal and axial flow pumps and deals with the precautions necessary to insure satisfactory operation.

February 1948

428 pages $7.50

Compressed Air Magazine, 942 Morris St., Phillipsburg, N. J.

R. C. PILOT VALVES FOR POSITIVE CONTROL

R-C Unloader Pilot Valves (plain or strainer type) are standard on many leading compressors...installed as replacements on thousands of compressors in all parts of the U.S.A. and overseas. The R-C valve—positive in action—cannot chatter...it's always in open or closed position. Adjustment is provided for any unload-to-load range from 3% to 30% of maximum receiver pressure. Install an R-C Unloader Pilot valve—let performance prove its value. Specify air pressure and range of on-and-off operation desired. Write for price and recommendation.

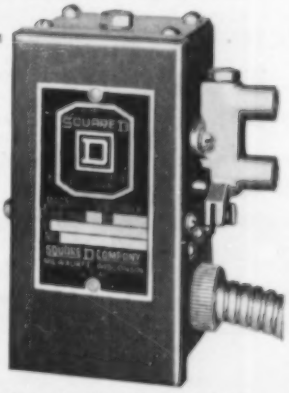
R.C. PILOT VALVE STRAINER TYPE

R. CONRADER CO.
1207 FRENCH STREET · ERIE, PA.
PILOT VALVES for Portable and Stationary Air Compressors provided with Unloaders

New CLASS 9045 TYPE BG MAGNETIC UNLOADER

Provides POSITIVE unloading of air-compressor at end of operation or when voltage failure occurs

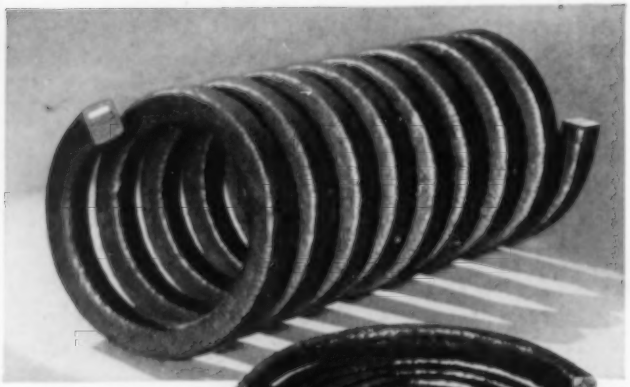
FEATURES



- Release valve is located conveniently on the side of the unloader enclosure. Moisture, condensed by the rapid expansion of the unloaded air, is blown into the atmosphere. The solenoid coil and interior working parts remain dry and free of moisture.
- Coils are available for use with all standard voltages and frequencies. Dual voltage coils are commonly furnished in 110/220 V and 220/440 V ratings.
- Magnetic unloaders can be furnished with either two-way or three-way valves. The two-way valve exhausts the air between check valve and compressor head directly into the atmosphere. The three-way valve serves as an auxiliary valve to provide actuating air for a compressor unloader.

Write for Bulletin 9045, Square D Company, 4041 N. Richards Street, Milwaukee 12, Wis.

SQUARE D COMPANY
DETROIT · MILWAUKEE · LOS ANGELES



GARLOCK 150 Asbestos High Pressure Steam Packing

GARLOCK 90 Waterproof Hydraulic Flax Packing

GARLOCK 777 Rubber and Duck Low Pressure Packing

GP

Good Prescription FOR YOUR PACKING PROBLEMS

A good practical prescription for packing troubles is to specify GARLOCK. The three rod packings illustrated are typical of the many fine *quality-controlled* packings in the GARLOCK line. Also specify GARLOCK gaskets and KLOZURE oil seals for long, dependable service.

THE GARLOCK PACKING COMPANY
PALMYRA, N. Y.
In Canada: The Garlock Packing Company of Canada Ltd., Montreal, Que.

GARLOCK PACKINGS

PURITY ★ S ★ PAYS OFF

Pure air, too, pays off—at the business end of air tools and cylinders. For sweet pneumatic tool performance choose . . .

NORGREN TRANSPARENT BOWL FILTERS

- ★ *Tornado Jet action positively checks water and emulsion.*
- ★ *Double Monel wire screen stops all solids.*
- ★ *Quiet Zone traps muck and moisture.*
- ★ *Transparent bowl tells when to drain.*

WRITE FOR DETAILS. C. A. NORGREN CO.
222 Santa Fe Drive
Denver 9, Colorado

Norgren

PROTECT Compressed Air Systems

QUICK FACTS

1. **AUTOMATIC DRAINAGE.** Armstrong Air Traps work automatically. They stay on the job 24 hours a day to protect equipment against water damage.
2. **AIR SAVINGS.** Compressed air costs money. Armstrong Air Traps blow down condensate without wasting air. No worry about hand operator failing to close valve.
3. **TROUBLE-FREE PERFORMANCE.** Armstrong offers Air Traps for every purpose. The line is complete with types to handle toughest jobs.
4. **LOW COST, HIGH QUALITY.** Stainless steel trim. On a capacity basis they can't be beat.
5. **RECOMMENDATIONS.** Complete information and recommendations on request. ARMSTRONG MACHINE WORKS, 885 Maple St., Three Rivers, Mich.

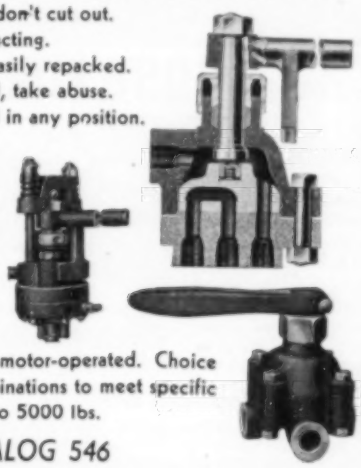
ARMSTRONG AIR TRAPS

STANDARDIZING ON Nicholson Valves PAYS OFF

→ MAINTENANCE MEN LIST 5 REASONS

A survey of large users of Nicholson cylinder control valves shows these leading reasons for their specification:

1) Special seats, don't cut out.
2) Fast, positive acting.
3) Stuffing box easily repacked.
4) Heavy-bodied, take abuse.
5) Neat, installed in any position.



Nicholson control valves are furnished for all mediums — air, gas, steam, water, oil; and for all types of operation — lever, foot, solenoid and motor-operated. Choice of six metal combinations to meet specific needs. Pressures to 5000 lbs.

CATALOG 546

W. H. NICHOLSON & CO. 180 OREGON STREET WILKES-BARRE, PA.

Valves ★ Traps ★ Steam Specialties

Here's the New AIR PRESSURE REGULATOR

—That Pays for Itself!

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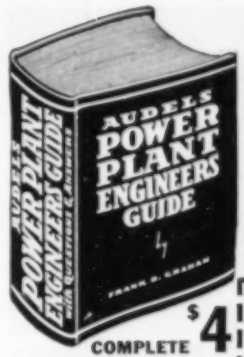

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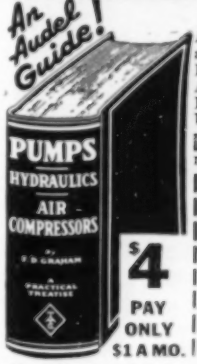

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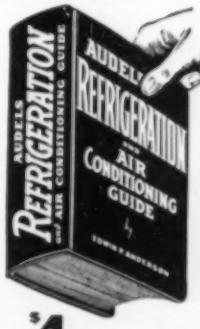

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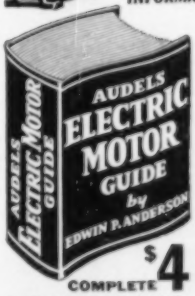

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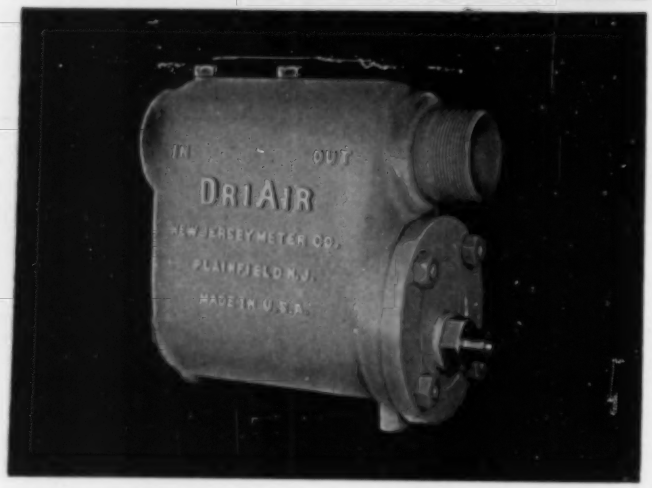

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E	1850	8
F	1850	8
G	1850	8
H	1830	8
I	1800	11
J	1800	7
K	1750	11
L	1750	11
M	1750	8
N	1745	2
O	1745	2
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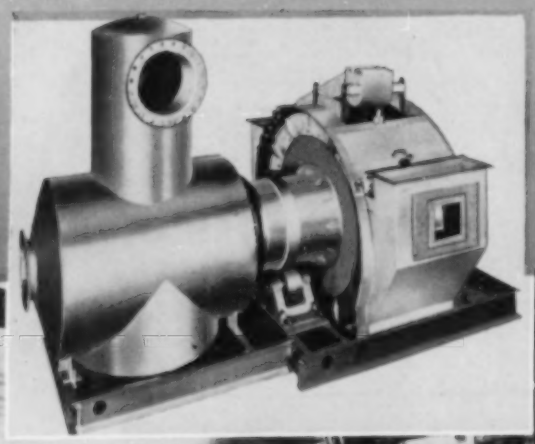

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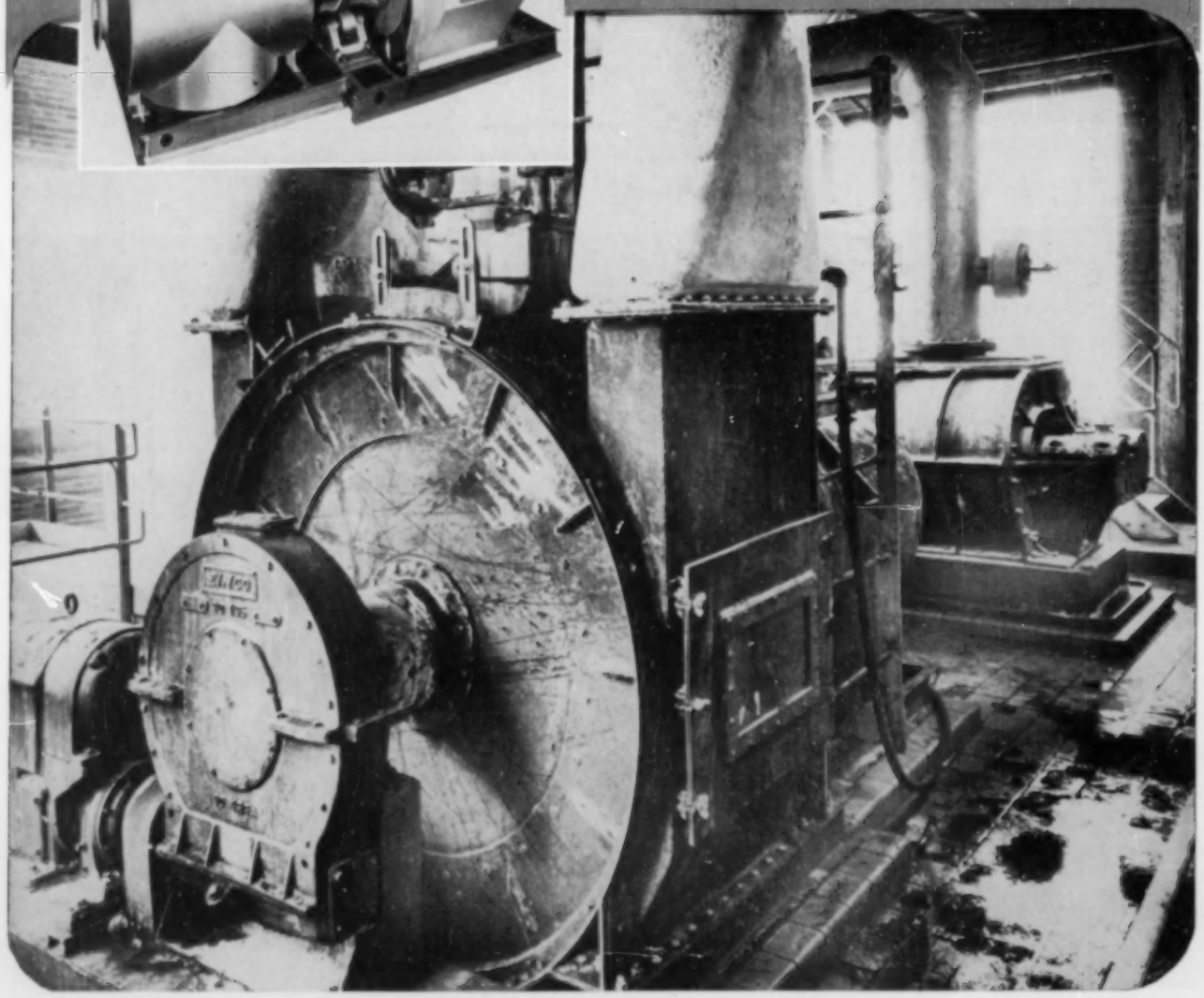

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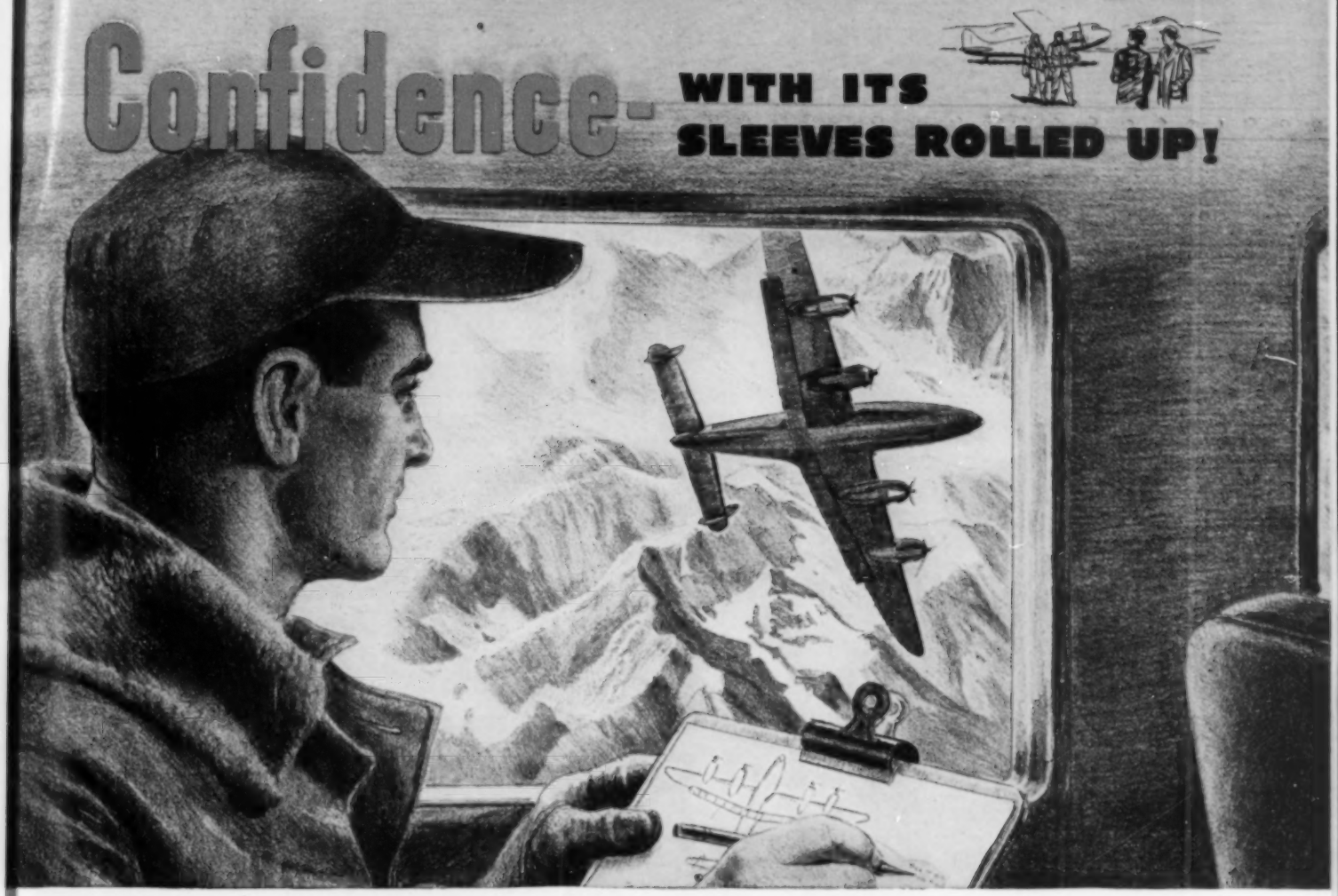

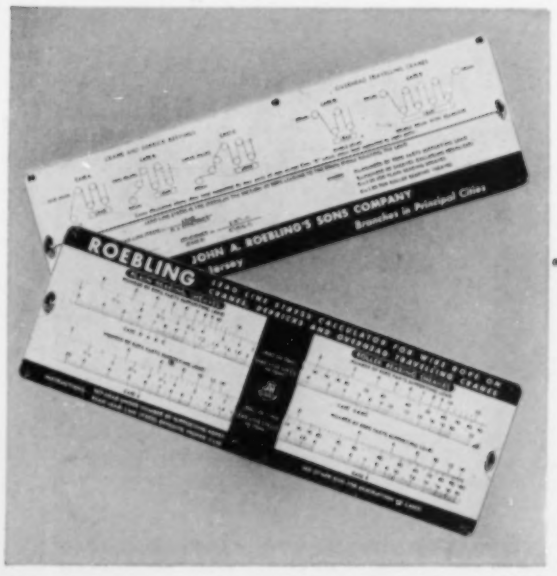

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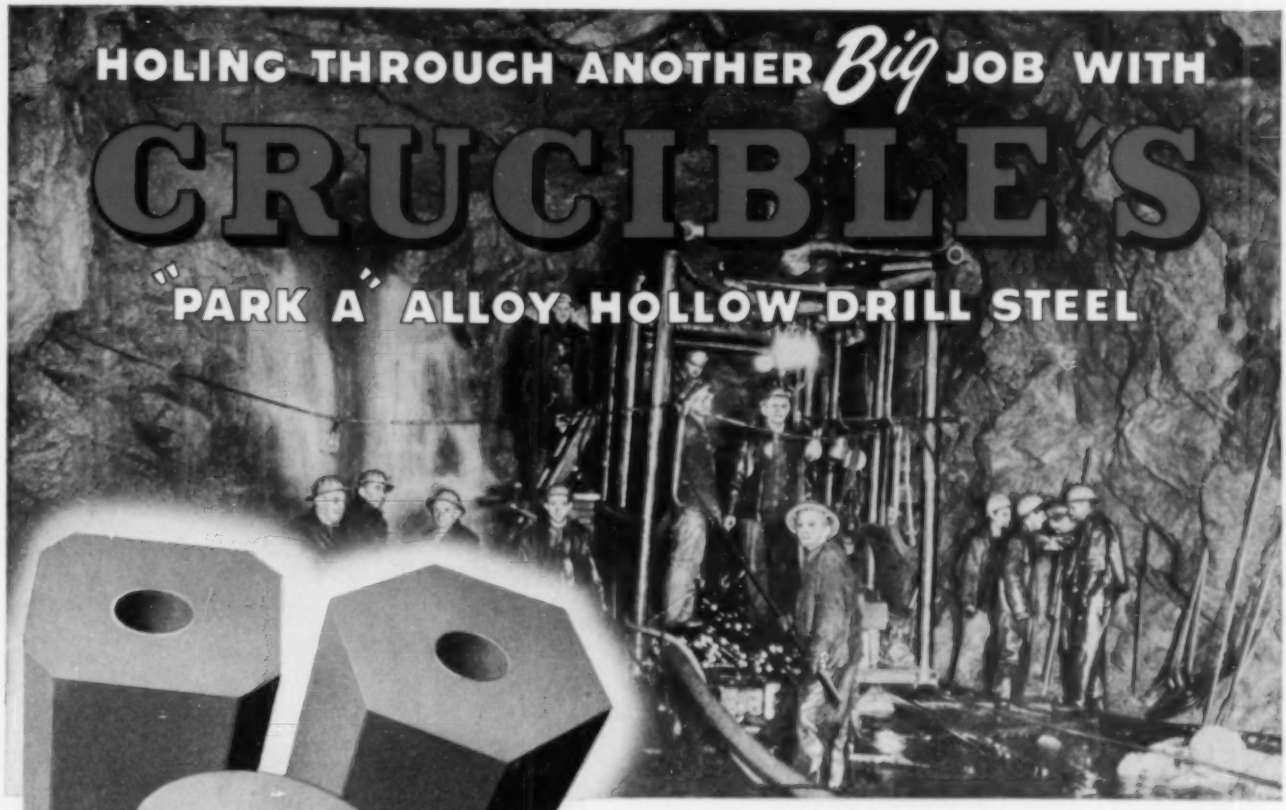

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